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Grave Danger of General Wage Reduction

If Prices Decline—Great Output of Pig Iron and Finished Materials Last Year—Heavy Shipments from Western Mills

Although the past year was marked by decreased consumption and lower prices than the preceding year, about a million and a half tons more pig metal and slightly more finished steel products were turned out than in 1907, the hitherto banner year. During 1910, the mills and blast furnaces were not fully employed, but the figures of the census and other favorable indications give substantial reason for expecting that there will be no surplus capacity when present unfortunate conditions, due largely to political agitation, are changed. The year was also remarkable for heavy shipments. For example, it is estimated that while the total sales of steel products in the Chicago territory for the year amounted to 2,000,000 tons, a shrinkage of about 50 per cent, compared with 1909, the shipments for the past 12 months were nearly equal to those of the preceding year. It is believed that in the west, especially, stocks are low, and that the booking of heavy tonnages cannot long be delayed.

Wages and Prices

Early last year, the Frick Coke Co. advanced the wages of all its employes, and many steel companies soon after took similar action. At the beginning of this year, the most serious problem that confronts employers and employes is how to maintain the present scale of wages. There has been an average reduction of about $7 per ton in the price of finished products, compared with those of 1907, although the cost of production has increased. Officials of the steel companies assert that no concessions in prices will be possible except through a reduction in wages, which would be most unfortunate under present conditions of the cost of living, and, in view of the wage increases granted railroad employes, would cause profound dissatisfaction among the workingmen of the steel mills. At a meeting of leading iron and steel executives in New York within a few days, it developed that there is a large element strongly opposed to any price reductions, and it is by no means settled that any price cuts will be favored at the general meeting of manufacturers Jan. 11. In fact, it can be safely predicted that no lowering of quotations will be recommended, unless trustworthy evidence can be presented that such action would stimulate permanent improvement. Many leading producers and their salesmen are opposed to any price changes until there are clear indications that buyers would order freely at lower prices.

Iron Ore

No meeting of the Lake Superior ore interests has been held, nor has the price question been considered either formally or informally. It is understood, however, that at two meetings held in the east by consumers and producer-consumers, one a number of weeks ago in connection with the American Iron and Steel Institute and another within a few days, there was sentiment in favor of maintaining last year's prices on ore. The ore men will receive advice cautiously, for they have not forgotten their experience in 1908, when they were persuaded to announce prices prematurely, and were later compelled to reduce their quotations. This year is expected to show a sharp reduction in the movement of Lake Superior ores as compared with last year, but a recent estimate of 25,000,000 tons is generally regarded as much too low. Although the amount of ore on hand at present is very large, it is certain that it will be greatly reduced by June 1, the date at which furnaces count upon getting mixtures of new ore.

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NEAR ADJUSTMENT

Are Questions Concerning Rail Specifications.

New York, Jan. 4. (By wire.)

Questions arising in connection with new test requirements and specifications of the Pennsylvania and New York Central for rails are approaching adjustment and orders for 150,000 each are expected to be put on mill books in January. The New York Central order may be formally closed in a week or ten days. More promising developments in rails are expected in January. The New York, Ontario & Western placed 1,000 with the Pennsylvania and 4,000 are understood to have gone to the Bethlehem Steel Co. The New York Ship Building Co. has taken a training ship for the Chinese navy, which will require about 1,800 tons.

MORE CONTRACTS

For Furnace Coke—Bethlehem Steel Co. Makes Contract.

Pittsburg, Jan. 4. (By wire.)

Several additional contracts for furnace coke for delivery over the first six months and all of 1911 are noted in this market. The Bethlehem Steel Co. has closed for part of its requirements for the entire year, and is negotiating for the remainder of its requirements, aggregating about 15,000 tons a month. Most of the trading for first half has been done on a basis of $1.60, ovens. Sellers generally expect a heavier buying within the next 30 days. Notwithstanding that sales have been reported recently as low as $1.40, ovens, for prompt shipment, sales have also been made at $1.50, ovens. The foundry coke market is showing little activity, but prices are unchanged. Production in the Connellsville region for the week ended Dec. 21 amounted to 292,445 tons.

Structural Contracts

New York, Jan. 4. (By wire.)

Only a limited tonnage of structural material is being placed. New inquiries include 1,400 tons for the East river pier and a number of bridges near Rome, N. Y., about 4,000 tons both for the New York Central; and 600 tons additional for the Boston & Maine; 450 tons for the Lake Erie & Western went to the Jones & Laughlin Steel Co.

Tennessee Earnings

A report of earnings for the first ten months of the present year has been submitted to the New York stock exchange by the Tennessee Coal, Iron & Railroad Co., in connection with the listing of additional bonds. The balance of income and earnings after charging off depreciation and interest charges was $2,028,258. The payment of interest upon a small block of preferred stock still outstanding, the charge of which amounts to $7,470, leaves a total surplus on Nov. 1, 1910, with what had previously been accumulated, of $3,498,392. In 1907 the net profits, after allowance for depreciation, extraordinary replacements and net interest charges on bonded and oating debt, were $1,426,-684.

MACHINE TOOL OUTPUT

Increased in Cincinnati—Prospects are Considered Favorable.

Cincinnati, Jan. 4. (By wire.)

The output of machine tools by local manufacturers during 1910 exceeded that of 1909 by about 10 per cent, making total estimated business for the year of approximately $145,-000,000. Enough new plants and extensions are projected to insure heavy production during the present year, if conditions are at all favorable. So many disturbing elements have entered into business in the past year that it has been far from satisfactory, although an improvement over 1909. The prospect at present is good, with orders and inquiries about normal. Business by the car builders the past year has been heavy, and many buyers who had put off buying as long as possible came into the market. Indications for the present year are good and it should be a banner year. Due to the uncertainty that has made buyers timid, dealers and jobbers have reduced stocks to a minimum. All deliveries of raw material are up to date. Should any general buying movement set in, manufacturers will have a hard time filling the demand, as a majority have curtailed production.

Rolling Mill Improvements

Improvements which have been in progress for some time at the plant of the Union Rolling Mill Co., Cleveland, are nearly completed. The old 9-inch mill is replaced by a Belgian mill. There will be a 14-inch roughing mill and a 9-inch finishing mill. There will be a hot bed 150 feet long. The time of beginning operation at the new plant will depend upon business conditions.

EASTERN ASSOCIATION

Elects Officers—Waiting with Reduced Output.

New York, Jan. 4. (By wire.)

Albert Broden, of the Reading Iron Co., was elected president of the Eastern Pig Iron Association for the ensuing year. W. S. Pilling, of Pilling & Crane, Philadelphia, was re-elected secretary. The closing monthly meeting of the association of the year at Philadelphia developed the sentiment among eastern producers. The situation is regarded as simply one of waiting with restricted production. The eastern output is about 60 per cent of capacity and the statistical position in December as to stocks and orders is unchanged over previous months.

Furnaces are still blowing out, one, Alburtis stack, of the Thomas Iron Co. having stopped. In Virginia seven of 21 furnaces are in blast.

The American Locomotive Co. has booked 30 locomotives for the Imperial Railroad of Japan.

SOUTHERN PRICE

Is $11 for First Half—Pig Iron is Very Quiet.

Cincinnati, Jan. 4. (By wire.)

One or two small inquiries represent all the activity in pig iron circles and the market is stagnant. The sentiment prevails that the process of curtailment will be continued until production is where it should be and that without lowering of prices to any extent.

The year opens with established quotations for southern iron at $11.00, Birmingham, with northern brands on a $14.00, Ironton, basis. While there may be exceptions to the general rule, it is absolutely certain that these prices will apply on any delivery during the first six months. Quotations remain as they were last week.

Coke is quiet and most of the contracting for the year's requirements has been taken care of. Prices from the leading coke producing districts are unchanged from last week's schedule. The finished material market, while quiet, is holding firm as to quotations, 1.40c, Pittsburg, representing the market on bars, shapes and plates. Old material is in light demand and little new contracting is being done. Prices are somewhat erratic.

New York Copper Exports

Copper exports for December totaled 31,526 tons, against 28,104 tons for December in 1909, an increase of 3,422 tons.

PIG IRON SELLING

In East Continues Light, Although Prices are Maintained.

Philadelphia, Jan. 3.

In all branches, the iron and steel market in this territory is beginning the year under very quiet conditions. Open pig iron selling is light and where sizeable lots are being placed they are usually the result of private offers. Another Lehigh valley furnace has gone out. The customary weekly total of lower silicons was taken the past week by the cast iron pipe makers, several thousand tons being included, among which was a small lot of southern forge at $9.75, Birmingham, or $13.95, delivered. Foundry irons are unchanged. The Pennsylvania railroad order for 900 to 1,800 tons is still pending. Malleable continues quotable at from $16 to $16.25, delivered here. The basic market is squarely on the basis of $14.50, delivered. Consumers are carrying over a considerable tonnage on old contracts and are putting out no new inquiries. There is more stir in the low phosphorus market. One round lot has been closed at $20, New York furnace, equivalent to $22.50, Philadelphia, and other negotiations are under way.

The recent purchase of some foreign low phosphorus ores, at about 10½ cents per unit, Philadelphia, has placed some makers in the position of more active sellers. Low phosphorus ores are scarce and some sellers will not quote the iron at less than $22 to $22.25, furnace.

Eastern plate makers this week have closed additional large contracts with consumers for first quarter at 1.40c, Pittsburg, and are not anxious to book for first half at this level. Otherwise there is little life to the market. The Jones & Laughlin Steel Co. has taken 1,200 tons of reinforcing bars for the Panama canal. A difference of only about $50 separated the several bids submitted in this contract, which involved about $36,000, reflecting the firmness of bar prices. The city department of docks has put out an inquiry to close Jan. 15 on the 2,000 tons or more steel for the superstructure of the Vine street piers. The Reading railroad is out for the steel for several coal pockets. The Norfolk & Western inquiry for bridge steel and the Chesapeake & Ohio's for car underframes material are still pending.

Old material continues dull. While $12.50, delivered, represents the heavy steel market, consumers are having some difficulty to get more than small lists at this figure. A sale of 1,000 tons of prompt furnace coke at about $1.50, ovens, is noted.

BUILDING PROJECTS

Which Will Call for Large Tonnages of Steel—No Basic Meeting.

Several building projects in Cleveland are being pushed forward to the stage where bids for steel material will be asked for within a short time. The architects for the proposed 14-story *Leader* building announce that it will be built and ready for occupancy in the spring of 1912. The Marshall Drug Co. announce plans to build a 14-story structure on the Public square, the ultimate intention being to occupy an entire block on Superior avenue west of the square. Quite a number of inquiries for small tonnages of angles, shapes, etc., in 50 to 100-ton lots have been sent out this week. One Pittsburg mill took one of these small orders last Thursday because delivery was guaranteed this week, whereas competitors quoting the same price could not make delivery until next week. The Ford Glass Co.'s factory, 1,400 tons, will be let at Toledo this week, and the Flower hospital in that city, partly re-inforced concrete, will soon be ready for bidders on steel.

Sweeping denial is made by basic pig iron makers, with offices in this city, that any meeting whatsoever of basic pig iron makers has been held in Cleveland, either on last Friday or any other day last week. At least, if such a meeting was held, the larger producers declare they never received so much as an invitation to it.

Two 2,000-ton lots of rolling billets from mills in the Cleveland district have been inquired for. Delivery in January and February is asked in both instances. Prices quoted, although the usual base, appear not to be attractive to the prospective purchasers.

Carnegie Banquet

Pittsburg, Jan. 4. (By wire.)

The annual banquet of the operating department of the Carnegie Steel Co. will be held at the Duquesne Club, Pittsburg, Saturday evening, Jan. 7.

The annual meeting of Rogers, Brown & Co. will be held in Cincinnati, Jan. 17, 18 and 19, when the usual business meetings and social functions will take place.

Ensley No. 5 stack, of the Tennessee Coal, Iron & Railroad Co., was blown out Dec. 23, and No. 6 on Dec. 22.

FOR URGENT NEEDS

Consumers Are Placing Orders—New Production Records.

Pittsburg, Jan. 4. (By wire.)

The new year opened with consumers of iron and steel buying only for urgent needs, pending the outcome of the meeting of manufacturers to be held in New York on Jan. 11. Developments in some quarters during the past week have been rather encouraging, and the indications point to a more general buying during the latter part of January, although the trade generally does not look for any material improvement for a few days. Several local steel companies report that the total tonnage entered on mill books in December exceeded that of the preceding month. In some branches, the December record was the high production record of the second half of the year, while in a few instances new high production marks were established for the year.

Contrary to expectations, definite action has not yet been taken on some of the inquiries for freight cars noted recently. Car builders and steel companies estimate that inquiries are pending for approximately 20,000 freight cars.

Bids on the new battleship for Chili, which will require from 10,000 to 12,000 tons of hull material, have been postponed until March 1. The Carnegie Steel Co. has taken two export orders for sheet piling, involving 500 tons each, and one for 700 tons for a New England railroad.

Prices on all finished lines at present are firmer than a month ago. Steel bars, shapes, plates and bar iron are at 1.40c, Pittsburg, although concessions on bar iron are being made in the territory both east and west of Pittsburg. The market on sheets is firm at 2.20c for black No. 28 gage; 1.65c for blue annealed No. 10, and 3.20c for galvanized No. 28 gage, and there is more general buying for prompt shipment. Consumers of tin plate are specifying rather freely for first half shipment and the market is firm. Jobbing interests are beginning to specify against contracts for wire and nails, although there is not a great deal of new business appearing. The market is quotable at 1.50c on plain wire; 1.70c on wire nails, and 1.65c to 1.70c on cut nails. The market on pipe is not very active, and comparatively little tonnage is under active negotiation. Iron and steel mills are starting the year with comparatively little tonnage on their books.

Better Showing Than Price Curves Indicate

Heavy Consumption, but Not Great Enough to Keep Up With Increased Capacity—Trend of Events in the Pittsburg District

By L. P. Sutter.

While the high hopes entertained for the iron and steel trade at the beginning of the year did not materialize, statistics for the various branches of the industry in the Pittsburg territory for the 12 months ended Dec. 31 will make a more creditable showing than the price chart for the year 1910 would indicate. In many respects, the year has been unique. Production, particularly during the first half, established a new high record; consumption for the same period was exceedingly heavy; wages of all classes of labor were advanced, while prices on all products, with the exception of rails and tin plate, declined from $1 to $7 a ton from the initial month. The explanation of the downward trend of the market during the past year is an excess in capacity over demand. The gap between capacity and demand is attributable to extensions in capacity rather than to curtailment in consumption.

The recovery of the year 1909 was exceedingly rapid and the opening month of 1910 found practically every branch of the iron and steel trade in the Pittsburg territory running full time with from three to five months' work on books. Had the volume of new business continued up to Sept. 1 at the same rate as for the fourth quarter of 1909 and the first three months of 1910, new high production records would have been established in practically every branch, and prices would not have dropped to the low level established during the final quarter of the year. At the end of the first quarter, however, a gradual slowing down in business set in and a few months later producers began to report an increase in shipments over new orders. This feature became more noticeable as the months passed, buying tapering off moderately, but steadily, with the result that at the close of the year actual bookings were less than 50 per cent of the producing capacity.

One of the numerous disappointing features of the trade during the past year was the attitude of the railroads, the market receiving very little support from transportation companies. During the initial quarter, it became evident that new construction programs would not be very extensive. It was believed, however, that the consumption of iron and steel by the railroads in renewal and betterment work would enable the steel companies to maintain a fair production rate throughout the year, but the controversy over proposed freight rate advances which followed resulted in a more stringent retrenchment policy on the part of the carriers than ever before. Political uncertainties and pending anti-trust cases also contributed to making the past year one of doubt and uncertainties.

Prices began to decline early in the year, reductions of $1 a ton having been made at a time in several lines. Price concessions on finished materials were first reported on wire products early in February. The following shows price reductions, per ton, from the first week in January to Dec. 1: Bessemer pig iron, $2; basic pig iron, $3.75; Bessemer billets, $5; open-hearth billets, $6; Bessemer sheet bars, $4; open-hearth sheet bars, $5; wire rods, $5; bar iron, $7; steel bars, $2; tank plates, $3; beams, $3; black sheets, No. 28 gage, $6; blue annealed sheets, No. 10 gage, $4; galvanized sheets, No. 28 gage, $7; hoops, $1; bands, $1; wire nails, $3; plain wire, $3; cut nails, $4; heavy melting steel, $4.25. Still further concessions in some lines were made by the smaller mills during the early part of November. A meeting of iron and steel manufacturers was held in New York, in November, when it was decided that a general reduction in prices would not result in increased buying, but the ruinous competition was not checked until about the middle of December, when a series of meetings was held by the representatives of the various branches of the iron and steel trade.

One of the noteworthy events of the year in the Pittsburg territory was the action of the Carnegie Steel Co., in discontinuing paying commissions to jobbers, following the opening of its Pittsburg warehouse and the starting out of a number of salesmen during the middle of October. At that time, there was considerable speculation as to what action would be taken by jobbers and there was talk of their lining up with independent manufacturers. Several weeks later, however, negotiations were taken up between the Carnegie Steel Co. and the jobbers, and at the close of the year indications pointed to an amicable adjustment of this controversy, at least so far as warehouse business is concerned.

New Construction.

The 1910 construction program on the part of large industrial concerns in this territory consisted chiefly of the completion of new works and additions, started in the preceding year, actual construction having been postponed indef-

AVERAGE MONTHLY PRICES, IRON AND STEEL PRODUCTS, PITTSBURG, 1910.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Bessemer Pig Iron	$19.90	$19.42	$18.90	$18.15	$17.09	$16.73	$16.40	$16.21	$15.90	$15.90	$15.90	$15.90
Basic Pig Iron	17.90	17.77	17.20	16.65	16.20	15.70	15.27	14.95	14.70	13.96	14.28	14.20
No. 2 Foundry	17.90	17.46	17.00	16.65	16.27	15.57	15.12	15.01	14.90	14.84	14.65	14.65
Gray Forge Iron	17.15	17.15	16.60	16.35	16.09	15.10	14.52	14.45	14.25	14.15	14.09	13.90
Ferro-Manganese	44.37	44.00	43.10	41.50	40.37	39.70	39.25	39.50	39.40	38.80	38.75	38.35
Bessemer Billets, 4 x 4	27.87	27.50	27.50	27.00	26.12	25.50	25.00	25.00	24.50	23.88	23.00	22.80
Rails (Standard)	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
Beams and Channels (15 inches and under)	1.55c	1.55c	1.52c	1.50c	1.50c	1.46c	1.41c	1.40c	1.40c	1.40c	1.40c	1.40c
Tank Plates	1.55c	1.55c	1.52c	1.50c	1.50c	1.46c	1.41c	1.40c	1.40c	1.40c	1.40c	1.40c
Steel Bars	1.49c	1.45c	1.45c	1.45c	1.45c	1.45c	1.45c	1.40c	1.40c	1.40c	1.40c	1.40c
Bar Iron	1.70c	1.70c	1.65c	1.55c	1.56c	1.53c	1.50c	1.46c	1.43c	1.40c	1.37c	1.30c
Sheets (28 gage black)	2.40c	2.40c	2.40c	2.35c	2.30c	2.26c	2.20c	2.20c	2.17c	2.15c	2.15c	2.14c
Sheets (28 gage galvanized)	3.50c	3.50c	3.50c	3.45c	3.40c	3.36c	3.30c	3.27c	3.21c	3.16c	3.15c	3.18c
Tin Plate	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60	$ 3.60
Wire Nails (jobbers)	1.85c	1.85c	1.85c	1.85c	1.81c	1.80c	1.71c	1.70c	1.70c	1.70c	1.65c	1.68c
Hoops	1.59c	1.60c	1.60c	1.60c	1.49c	1.55c	1.55c	1.53c	1.50c	1.50c	1.50c	1.50c
Heavy Melting Steel	$17.56	$17.12	$16.80	$16.31	$15.25	$14.85	$14.06	$14.00	$14.10	$14.06	$13.87	$13.50
Malleable Pig Iron	18.15	17.92	16.95	16.80	16.25	15.61	15.77	15.52	15.10	14.52	14.09	14.20

initely, owing to the enormous producing capacity all over the country and the downward trend of the market. The Jones & Laughlin Steel Co. completed the last three of its group of four furnaces at Aliquippa, Pa., and rebuilt No. 1 stack of the Eliza group at Hazlewood, Pa.; the Andrews & Hitchcock Steel Co., Hubbard, O., rebuilt its No. 2 furnace. The Pittsburg Steel Co. announced plans for building two blast furnaces at Monessen, Pa. Four 250-ton Talbot basic open-hearth furnaces were completed at Aliquippa, Pa., by the Jones & Laughlin Steel Co.; the Forged Steel Wheel Co. completed and placed in operation six 50-ton open-hearth furnaces and a slabbing mill at Butler, Pa.; the Carnegie Steel Co. completed and placed in operation four open-hearth furnaces at Homestead, Pa.; the Cambria Steel Co., Johnstown, Pa., also completed four open-hearth furnaces, and the Republic Iron & Steel Co. made rapid progress on eight 60-ton open-hearth furnaces at Youngstown. Plans were completed for six open-hearth furnaces for the Youngstown Sheet & Tube Co.; also for three 60 to 75-ton open-hearth furnaces for the Whitaker-Glessner Co., Wheeling, W. Va., and six 60-ton open-hearth furnaces for the Ohio Iron & Steel Co., Lowellville, O., but no authority was given to begin work on these plants. The American Sheet & Tin Plate Co. awarded contracts for 16 sheet and four jobbing mills, to be built at Gary, Ind., and the Follansbee Bros. Co. began work on four new sheet mills at Follansbee, W. Va. A total of 36 new tin mills was placed in operation. The McKeesport Tin Plate Co. authorized the building of two new tin mills, and the Jones & Laughlin Steel Co. completed plans for 24 additional tin mills at Aliquippa, Pa.

Pig Iron.

The opening of the year found blast furnaces running to capacity and consumption greater than ever before. Large consuming interests auticipated a further advance in prices and during the latter part of 1909 covered for extremely heavy tonnage of all grades for delivery over the first quarter and first six months of the new year. As a result of the heavy buying during the latter part of the old year and the gradual falling off in demand early in the new year, comparatively few large sales were reported during the 12 months just ended. At no time after the first quarter was production restricted to consumption and as a result prices steadily declined throughout the remaining months. In February, the United States Steel Corporation closed for approximately 40,000 tons of Bessemer iron at $18, valley, a reduction of $1 a ton as compared with the initial month. This was the largest sale of the year and 15,000 tons of the total amount went to the Carnegie Steel Co. In March, the Cambria Steel Co. bought 10,000 tons at $17.50, valley, and in May and August, the Republic Iron & Steel Co. bought 2,500 tons at $15.60, valley, and 2,000 tons at $15, valley, respectively. Early in the third quarter, the price of Bessemer was firmly established at $15, valley, and this price prevailed throughout the remainder of the year, despite the fact that sales were very light.

At the beginning of the year, basic pig iron was selling around $17, valley. On Feb. 24, quotations were dropped to $16.15, valley, and another reduction of 50 cents a ton was noted on March 17. On April 21, another reduction of 50 cents followed and on May 19 the market was established at $15, valley. In July, the market declined to $14.50, valley, and on July 26, a Pittsburg middleman bought 10,000 tons at a flat price of $14, valley. Reductions of from 25 to 50 cents a ton followed, and on Oct. 13 sales of 1,000 and 2,000-ton lots were made at $13, valley. In November, the American Steel Foundries closed for 10,000 tons at $13.15, valley, and the Colonial Steel Co. bought 6,000 tons at $13.35, valley, for first half delivery. This is the one grade of pig iron on which a firmer market was established during the closing month of the year, all of the producing interests maintaining a firm price of $13.50, valley, for immediate shipment. Prices of foundry, malleable and gray forge declined accordingly, few important sales having been made during the year.

While stocks at the furnaces were high all through the year, conservative estimates at the close of the year placed the stocks in consumers' hands at less than 15 per cent of the total stocks of the country. On Dec. 15, nine of the 18 merchant furnaces in the Mahoning and Shenango valleys were operating. The furnaces in blast at that time were three Shenango, Stewart, Brier Hill, No. 1 Hubbard, Struthers, Cherry Valley and McKeefrey and the idle furnaces were the Alice, Claire, Ella, Fanny, Sharpsville, Girard, Hubbard No. 2, Mary and Tod.

Semi-Finished Material.

Notwithstanding that actual bookings of semi-finished steel during the last six months of the year show a heavy decline as compared with the corresponding period in 1909, several of the large producing interests in the Pittsburg territory report that the volume of tonnage entered on mill books during the past 12 months was only slightly below the total for 1909. The year opened with many large contracts on the books and the high rate of production of January was maintained throughout the first quarter. With the completion of new mills early in the year and the lighter demand for crude steel, as a result of the falling off in bookings of finished material, prices of Bessemer billets began to decline about April 1. The movement in Bessemer and open-hearth billets during the year was peculiar in some respects. In January and February, open-hearth billets were selling at $1 a ton above Bessemer billets. During the latter part of May the trend of the Bessemer market was downward and slightly higher prices were quoted on open-hearth steel. A few months later, the former differential of $1 a ton was again established and prices on both Bessemer and open-hearth were $2 a ton below those of the initial month. At the close of the year, Bessemer and open-hearth billets were quotable at $23, and Bessemer and open-hearth sheet bars were quotable at $24, makers' mill, Pittsburg, or Youngstown, a decline of $5 a ton on Bessemer billets, $7 a ton on open-hearth billets, $4.50 a ton on Bessemer sheet bars and $5.50 a ton on open-hearth sheet bars. Forging billets declined $4 a ton. The largest transaction in this market during the year was negotiated during the last week in July, when a large consumer of sheet and tin bars, near Pittsburg, closed with two producing interests for its total requirements of approximately 8,000 tons of sheet bars a month for a period of five years on a sliding scale basis. One of the important developments in this market occurred early in December, when it was decided to quote semi-finished steel f. o. b., makers' mill, Pittsburg or Youngstown, with full freight to destination added, instead of f. o. b. makers' mill, Pittsburg, which had been customary in previous years. In December, the low quotations of $22.50 on open-hearth billets and $23 on open-hearth sheet bars, which had been made in a few instances by small mills, were withdrawn.

Merchant Bars.

A very satisfactory record in steel bar production was maintained throughout the first half of the year. When the year opened, steel bar mills were operating to capacity and were four and five months behind in shipments. Farm implement manufacturers anticipated an exceptionally busy season and in numerous instances premium prices were paid for delivery within two months after receipt of order. About Feb. 1, there was a noticeable falling off in consumption and the mills began to show some improvement in delivery periods, although operating at an exceptionally

high rate. Prices declined about $1 a ton in February and the market was held at 1.45c, Pittsburg, until Aug. 1, when another reduction of $1 a ton was made and the new rate was maintained throughout the remaining five months. During the third quarter, buying was limited and by Sept. 1, consumers were buying only for urgent needs. Early in November, some of the large implement makers of the west began to specify against running contracts for shipment over the first quarter of 1911 and the December production record was slightly above that of the preceding month.

Owing to the retrenchment policy of the railroads and other large consumers of bar iron, this market suffered a heavy decline in prices during the year. Early in January the market was firm at 1.70c, Pittsburg, and during the closing month sales were made in a few instances at 1.35c, Pittsburg, a reduction of $7 a ton, while some of the western mills shaded quotations of 1.30c, Pittsburg. On Dec. 15, the Republic Iron & Steel Co. awarded contracts for the building of a new 16 and 14-inch continuous steel mill on the site of the old Brown-Bonnell iron works at Youngstown and announced that the former iron plant would be razed in February, 1911.

Plates.

The car building industry ran along very smoothly during the first half of the year, on account of the heavy buying of rolling stock late in 1909, which gave the car builders a large accumulation of business at the opening of the new year. In the course of a few months, freight shipments began to decline and railroads were not anxious for immediate delivery of cars and in addition to holding up deliveries, some of the lines endeavored to cancel orders previously placed. From Feb. 1 until Sept. 1, there was a general slowing down in car buying, and about Sept. 15 the output of the leading car building plants was reduced. At the close of the year, the output of some plants was about 15 per cent of their total capacity. The outlook for car buying in 1911 is decidedly bright, as car shortages are reported on many of the larger lines and many of the small wooden freight cars now in service will be abandoned and will be replaced by modern equipment. Boat building during the year was fairly active, although not up to expectations. About Sept. 15 the Carnegie Steel Co. was awarded a contract for 20,000 tons of plates, etc., for a Canadian car company, and 15,000 tons of hull material and deck plates for the new battleship Texas. Inquiries pending for new boat construction at the close of the year aggregated from 20,000 to 30,000 tons. Prices of plates declined from 1.55c, Pittsburg, in January to 1.50c, Pittsburg, on March 17; 1.45c, Pittsburg, on June 9, and 1.40c, Pittsburg, on July 14.

Structural.

The total structural steel tonnage offered to fabricators and manufacturers during the year was much heavier than production records a few months ago would indicate. In the immediate Pittsburg district, new construction work was comparatively light and local mills and fabricators received the bulk of their tonnage from other sections of the country. The largest single order booked by local interests during the year was the general contract awarded to the McClintic-Marshall Construction Co. by the Panama Canal commission for the Panama canal lock gates, involving 40,000 tons of plates, 18,000 tons of shapes and 12,000 tons of steel castings. The contract for the plates and shapes was sub-let to the Jones & Laughlin Steel Co., and the order for the castings was placed with the Wheeling Mold & Foundry Co. The McClintic-Marshall Construction Co. also booked 12,000 tons of structural work for the Western Maryland railroad extension and the plain material will be furnished by the Jones & Laughlin Steel Co. The Ft. Pitt Bridge Co., Pittsburg, booked an order for 12,000 tons of grade crossing elimination and elevation work on the Long Island railroad and the plain material is being furnished by an independent interest. Another large project on which bids were submitted during the year was the Quebec bridge, involving upward of 50,000 tons of steel, but the contract for this work has not yet been awarded. Competition among fabricators was very keen and some extremely low prices were quoted. Prices of structural steel declined about $3 a ton during the year.

Rails.

It is estimated that the rail production in the United States during the year 1910 was in the neighborhood of 3,000,000 tons, or about equal to that of 1909, compared with 1,921,611 tons in 1908 and 3,633,654 tons in 1907. Owing to the retrenchment policy of the railroad companies, comparatively little rail tonnage was used in extension work and the tonnage required for renewal and betterment work was kept down to the minimum, notwithstanding the high hopes entertained at the opening of the year. So far orders have been placed for upward of 350,000 tons for 1911 delivery, of which 150,000 tons, the Pennsylvania Railroad Co.'s order, has not been accepted by the steel companies. It is estimated that the Pennsylvania railroad used 75,000 tons of steel rails for renewals alone in 1910 and that a much larger tonnage will be required in 1911. The Pittsburg mills were not operated to capacity at any time during the year. On July 17, the combination rail and billet mill of the Carnegie Steel Co. at the Ohio Works, Youngstown, was started on open-hearth rails. This was the first time in three years that rails were rolled at Youngstown and the first time that open-hearth rails were rolled in the history of the plant. The order was for export trade. During the latter part of October, when the steel companies opened books for 1911 rail orders, it was announced that in the future prices on domestic rails would be quoted on a 100-pound unit basis, placing steel rails in line with other finished materials.

Sheets.

The trend of the sheet market during the year was similar to that of other finished lines, although the decline in prices and output was more marked than in some of the other branches. Early in the year mills were running to capacity and it was expected that a new high production record would be established on account of the increased buying on the part of automobile manufacturers and farming implement makers. During the early part of May, manufacturers of automobiles began to cut down their specifications and prices declined steadily from that time on. At the opening of the year, black sheets No. 28 gage and galvanized sheets No. 28 gage, were quoted at 2.40c and 2.50c, Pittsburg, respectively. On Dec. 1, black sheets were selling around 2.10c, and galvanized sheets were selling around 3.15c, Pittsburg. The decline in prices of blue annealed sheets was not so pronounced as on other grades. Notwithstanding that during the latter part of November the sheet industry was running at 50 per cent capacity, it is not believed that the total production of the year will fall very far below the record for 1909. Owing to the heavy output during the first half of the year and the increase in producing capacity, some of the larger producers show a slight gain as compared with their record for 1909. The American Sheet & Tin Plate Co. broke all production records in March by 2,000 tons, in spite of the fact that the Aetna-Standard plant, with a capacity of 12,000 tons a month, was idle. At that time, the company was operating 84 per cent of its total capacity, as compared with 58 per cent for the same period in 1909. During the year, 30 new tin mills were placed in operation, including eight of the Inland

Steel Co.; four of the Massillon Rolling Mill Co.; one of the National Sheet & Steel Co.; one of the Stark Rolling Mill Co.; five of the Thomas Steel Co.; three of the West Penn Steel Co., and eight of the Youngstown Sheet & Tube Co. The following sheet mills were in the course of erection during the latter part of the year: American Rolling Mill Co., ten; Canton Sheet & Steel Co., six; Follansbee Bros. Co., two; Phillips Sheet & Tin Plate Co., ten. The calling off of the strike against the American Sheet & Tin Plate Co. by the Amalgamated Association of Iron, Steel and Tin Workers, which began July 1, 1909, and the advance in wages for employes of the sheet mills were among the important developments of this market. On Oct. 4, manufacturers of sheets met in Pittsburg and made important changes in the rearrangement of differentials of the different grades of galvanized sheets. The new differentials have proved to be more favorable to the mills than the old and are intended to correct inconsistent differentials, which had long prevailed.

Tin Plate.

This is one of the two branches of the iron and steel trade, which did not suffer a general cut in prices during the year. The market was exceedingly active during the first nine months and there was little curtailment in output during the summer months. It is expected that official reports will show a substantial gain in production over the preceding year and the establishment of a new high record for the industry. A conservative estimate places the total production of 1910 at about 710,000 net tons, as compared with 613,000 tons in 1909; 537,087 tons in 1908; 514,775 tons in 1907; 577,562 tons in 1906, the latter being the high mark up to that time. Tin plate being a staple product owing to the uses to which it is put, this industry has been only slightly affected by business depressions. Consumption by canning interests during the past 12 months was exceedingly heavy, and, judging from the volume of business already booked for 1911, there is a busy season ahead for manufacturers. A total of 36 new hot mills was placed in operation during the year, including 12 mills at the Jones & Laughlin plant at Aliquippa, Pa., six of which were started May 3; 10 mills at the McKeesport Tin Plate Co.'s plant at McKeesport, Pa., five of which were started on April 5, and 12 new mills at the Phillips Sheet & Tin Plate Co., Wierton, W. Va. The Jones & Laughlin Steel Co. during the year announced that the Aliquippa, Pa., plant eventually will contain a total of 36 hot mills, and the McKeesport Tin Plate Co. awarded contracts for two new mills, which will be completed early this year.

Merchant Pipe and Boiler Tubes.

Activity in pipe line construction during the year just ended was not so pronounced as in 1909, although pipe mills operated on a more satisfactory basis throughout the year than was expected during the latter part of the first half, when the buying movement suddenly terminated. During the third quarter, some mills offered concessions from the official card, which became effective Jan. 1, and this was followed, on Oct. 1, by the National Tube Co. and independent interests issuing a new price card for steel pipe, representing a reclassification which had long been under discussion. The changes in prices on sizes of which the greatest tonnage is sold ranged in reduction of from $2 to $4 to advances of from $2 to $4 per ton, but on extra strong pipe the new card showed a reduction of from $8 to $20 per ton. The card adopted at that time also shows a distinction in the way of prices on lap weld and butt weld pipe. As compared with the card issued Jan. 1, 1910, the following changes were made: ⅛ to ¼-inch, butt-weld, a reduction of $4 a ton; ⅜-inch, butt-weld, a reduction of $2 a ton; ½-inch, butt-weld, a reduction of $2; ¾ to 1½-inch, butt-weld, a reduction of $2; 2 to 3-inch, butt-weld, a reduction of $4; 2-inch, lap-weld, an advance of $4; 4½-inch to 6-inch, lap-weld, an advance of $2; 7 to 12-inch, lap-weld, a reduction of $6. On Oct. 7, manufacturers of iron pipe issued a new basing card similar to the new card on steel pipe. In April the Republic Iron & Steel Co. started its new butt-weld department at Youngstown, making pipe 2½ inches and less in size, and the lap-weld department was started later. On April 14, the Youngstown Sheet & Tube Co. started two new butt-weld pipe furnaces and its new No. 10 lap-weld furnace, making pipe 14 to 20 inches, was started a few months later. Among the more important orders placed during the year were 200 miles of 12, 16 and 18-inch pipe for the Arkansas Natural Gas Co.; 175 miles of 6 and 8-inch pipe for the Gulf Refining Co.; 60 miles of 16-inch pipe for an Ohio gas company; 20 miles of 6, 8, 12 and 18-inch pipe for the Wichita Natural Gas Co. In addition to the above, several orders for from 10 to 15 miles of 6, 8 and 10-inch pipe were placed.

As a result of the retrenchment policy of practically all large railway systems, new orders for boiler tubes during the year were not very heavy, but the mills were enabled to maintain a moderately heavy production rate, as a result of the numerous large orders placed in 1909. The volume of business in merchant boiler tubes entered during the 12 months was considerably under the record for 1909. No important changes in prices were noted during the year.

Old Material.

Fluctuations in this market were similar to those in the pig iron market and prices on practically all grades at the close of the year were from $4 to $5 a ton below those quoted during the initial month. On Jan. 6, heavy melting steel was selling around $17.75; on Feb. 17, quotations were dropped to $17, and another reduction of $1 a ton was noted early in March. On June 2, the market dropped to $15, and early in December sales were made as low as $13.50, the prices of other grades dropping proportionately. Owing to the heavy direct contracting by consumers with producers of scrap late in 1909, there was comparatively little buying in this market during the year and the market attracted little attention during the last six months. The largest transaction reported was the deal made by the Carnegie Steel Co. with the McKeesport Tin Plate Co. for the total scrap output of the latter company, involving about 1,200 tons a month for a term of years.

Labor Conditions.

Many important changes affecting labor occurred during the year just closed. These included the calling off of the strike against the American Sheet & Tin Plate Co., Youngstown Sheet & Tube Co. and other companies by the Amalgamated Association of Iron, Steel and Tin Workers, and the increased wages paid to practically all classes of employes in the iron and steel industry. With the exception of slight disturbances at the McKees Rocks, Pa., plant of the Pressed Steel Car Co. and the general suspension of mining operations on April 1, the year 1910 was practically free from labor disturbances, as far as the iron and steel industry was concerned. Owing to the high production rate maintained during the early part of the year, many of the mills experienced considerable difficulty in finding enough men to operate their plants to capacity. The first wage advance was made on Jan. 1, 1910, when the H. C. Frick Coke Co. restored the wage scale to the level prior to the general reduction two years previous. This was followed by similar action on the part of independent coke companies. The next advance was given to between 40,000 and 50,000 coal miners in the Pittsburg district; a few months later, the United States Steel

Corporation announced a general advance in wages to all workmen at the mills, ranging from 1 to 6 per cent; similar action was taken a few weeks later by the Jones & Laughlin Steel Co., Republic Iron & Steel Co., Youngstown Sheet & Tube Co., and other large steel companies. After a series of meetings between the wage scale committee of the Amalgamated Association of Iron, Steel and Tin Workers and representatives of the Western Bar Iron Association and the Republic Iron & Steel Co., the last named company on July 19, after a two days' conference, reached an agreement on the iron wage scale for the year to July 1, 1911. The 1907 boiling scale was restored, involving an advance of 50 cents a ton in all but the lower numbers, the base rate remaining at $5, but advancing to $5.12½ on 1.05c bar iron instead of on 1.25c bar iron. Other changes were as follows: Busheling on cinder bottom—rates on heavy scrap advanced 10 cents throughout or about 5.4 per cent; busheling on sand bottom—an advance of 3.5 per cent; muck and puddle mill rates advanced 3.2 per cent; bar and 12-inch mills advanced 4.7 per cent. The Western Bar Iron Association during the following week signed the new scale and the men returned to work. The United Sons of Vulcan demanded a scale far above the previous scale and even higher than the advanced scale which the Republic Iron & Steel Co. granted the Amalgamated Association. Following the strike, which lasted for several weeks, the members finally agreed to accept the Amalgamated Association scale. Early in the year, some lodges of the Amalgamated Association started a movement to have the executive board discontinue the strike against the American Sheet & Tin Plate Co. On Aug. 9, a special convention, representing the various lodges, was held in Pittsburg and 63.2 per cent of the members voted to continue the strike. On Aug. 24, the national executive board met and agreed to call off the strike, which was declared July 1, 1909, and similar action was taken regarding strikes at the plants of the Youngstown Sheet & Tube Co. and other concerns, which refused to deal with the association in 1909. Several weeks before the strike was declared off, the American Sheet & Tin Plate Co. granted a general advance to sheet and tin mill employes, averaging slightly under 3 per cent above the 1909-10 scale. On June 22, independent sheet and tin plate manufacturers held a conference with representatives of the Amalgamated Association and the 1909-10 scale was reaffirmed. Practically all of the large railway systems also gave the trainmen an advance in wages, averaging slightly over 5 per cent. Beginning with the third quarter, steel companies in the Pittsburg territory began to close mills as a result of the decided falling off in business and at the close of the year many thousand employes were idle. Shortly before the holidays, it was reported in some quarters that steel companies were planning a slight reduction in wages to become effective the first of the year, but it was authoritively stated that this report was without foundation.

NEW CONSTRUCTION.

Blast Furnaces. (Non-Merchant.)

Aliquippa furnaces Nos. 2, 3 and 4, Aliquippa, Pa., Jones & Laughlin Steel Co. No. 2 stack was blown in early in February; No. 3 was blown in during the second quarter, and No. 4 was completed during the third quarter, but was not blown in.

C furnace, Youngstown, O., of the Youngstown Sheet & Tube Co., completed and blown in.

No. 1 stack of the Eliza group, Hazlewood, Pa., Jones & Laughlin Steel Co., rebuilt and blown in.

No. 2 stack of the Andrews & Hitchcock Iron Co., Hubbard, O., rebuilt and blown in.

Haselton furnace No. 4, Youngstown, O., Republic Iron & Steel Co., under construction; will be completed early in 1911.

Pittsburg Steel Co., Pittsburg, Pa., authorized plans to be prepared for two new furnaces to be built at Monessen, Pa., during 1911.

Blast Furnaces. (Merchant.)

No merchant furnaces were built during the year 1910 and no authority has been given so far for merchant furnaces to be erected in 1911.

Steel Works.

Jones & Laughlin Steel Co., four 250-ton Talbot tilting furnaces and one 400-ton mixer at Aliquippa, Pa., practically completed and ready for operation.

Forged Steel Wheel Co., Butler, Pa., six 50 to 60-ton open-hearth furnaces completed and placed in operation.

Republic Iron & Steel Co., six 60-ton basic open-hearth furnaces under construction at Lansingville, O., near Youngstown, to be completed before April 1, 1911.

Cambria Steel Co., Johnstown, Pa., four open-hearth furnaces completed and placed in operation.

Carnegie Steel Co., four 60-ton basic open-hearth furnaces completed at Homestead, Pa., works.

Sharon Steel Hoop Co., Sharon, Pa., one 50-ton open-hearth furnace completed and in operation.

Projected Steel Works.

Whitaker-Glessner Co., Wheeling, W. Va., plans prepared for three 60 to 75-ton open-hearth furnaces to be built near Martins Ferry.

Ohio Iron & Steel Co., Lowellville, O., plans prepared for six 60-ton open-hearth furnaces, with provision for six additional furnaces.

Youngstown Sheet & Tube Co., Youngstown, O., six 60-ton open-hearth furnaces to be built at Youngstown.

Sheet Mills.

Youngstown Sheet & Tube Co., eight mills completed.

West Penn Steel Co., three mills completed.

Thomas Steel Co., five mills completed.

Massillon Rolling Mill Co., four mills completed.

Stark Rolling Mill Co., one mill completed.

American Rolling Mill Co., ten mills under construction.

Canton Sheet Steel Co., six mills under construction.

Follansbee Bros Co., Follansbee, W. Va., two mills under construction.

Phillips Sheet & Tin Plate Co., eight mills under construction.

Tin Plate.

Jones & Laughlin Steel Co., new tin mill plant at Aliquippa, Pa., completed and plans prepared for 24 additional mills.

McKeesport Tin Plate Co., McKeesport, Pa., 10 mills completed and two mills under construction, making a total capacity of 22 mills.

Phillips Sheet & Tin Plate Co., 12 mills completed.

Tube Works.

Hazelton Steel Tube Co., four furnaces, two butt-weld and two lap-weld, completed and placed in operation.

A. M. Byers & Co., 46 new puddling furnaces completed and operating at Girard, O., giving a total of 48 single puddling furnaces.

Keystone Tube Co., Connellsville, Pa., new plant completed, capacity not given.

Other Finishing Mills.

Republic Iron & Steel Co., blooming, billet and sheet bar mills at Lansingville, O., completed and in operation.

Jones & Laughlin Steel Co., Aliquippa, Pa., wire and nail mills equipped with electric drive throughout and new rod mill, ten stands of the continuous type, completed; billet and bar mill, equipment comprising four 21-inch and six 18-inch mills, under construction; 40-

inch blooming mill, to be driven by a 20,000-horsepower Mackintosh, Hemphill & Co. twin tandem, compound, condensing engine, under erection.

Cambria Steel Co., Johnstown, Pa., splice bar plant enlarged; rod and wire mill under construction; semi-continuous 10 and 12-inch mills completed and in operation.

Forged Steel Wheel Co., Butler, Pa., slabbing mill completed and in operation.

Republic Iron & Steel Co., new 16 and 14-inch continuous steel mill to be built on the site of the Brown-Bonnell works in Ohio.

Pig Iron Prices

PITTSBURG.

(Prompt Shipment.)

Bessemer, valley	$15.00
Bessemer, Pittsburg	15.90
Basic, valley	13.50
Basic, Pittsburg	14.40
No. 2 foundry, Pittsburg	14.65
Gray forge, Pittsburg	13.90
Malleable, Pittsburg	14.40

(First Half.)

Bessemer, valley	$15.00
Bessemer, Pittsburg	15.90
Basic, valley	13.50
Basic, Pittsburg	14.40
No. 2 foundry, Pittsburg	14.90
Gray forge, Pittsburg	13.90
Malleable	14.40

CHICAGO.

(Prompt shipment and first quarter.)

Lake Superior charcoal	$17.50 to 18.00
Northern foundry No. 2	16.00 to 16.50
Southern foundry No. 2	15.35 to 15.85
Southern silveries, 5 per cent silicon	16.85 to 17.35
Jackson Co. silveries 8 per cent	19.40
Malleable Bessemer	16.00 to 16.50
Alabama basic	15.35 to 15.85

CLEVELAND.

No. 1 foundry	$14.75
No. 2 foundry	14.25
No. 2 Southern	15.35
Gray forge	14.00
Bessemer	15.90
Lake Superior charcoal	18.00
Jackson Co. 8 per cent silvery	19.00

CINCINNATI.

	First half.
Southern foundry No. 1	$15.25
Southern foundry No. 2	14.75
Southern foundry No. 3	14.25
Southern foundry No. 4	14.25
Southern No. 1 soft	15.25
Southern No. 2 soft	14.75
Southern gray forge	14.25
Northern No. 1 foundry	15.95
Northern No. 2 foundry	15.45
Northern No. 3 foundry	14.85
Jackson county 6 per cent silicon	18.20
Jackson county 8 per cent silicon	19.70
Jackson county 10 per cent silicon	20.20

PHILADELPHIA.

No. 1X foundry	$16.00 to 16.25
No. 2X foundry	15.50 to 15.75
No. 2 plain	15.00 to 15.50
Standard gray forge	14.25 to 14.50
Basic	14.50 to 14.75
No. 2X Virginia	15.65 to 15.80
No. 2 Southern	15.00 to 15.50
Low phosphorus	22.50

NEW YORK.

Northern foundry No. 1	$15.75 to 16.00
No. 2X foundry	15.25 to 15.75
No. 2 plain	14.75 to 15.25
No. 2 Virginia	15.30 to 15.80
No. 2 Southern foundry	15.25 to 15.75
Malleable	15.75 to 16.25
Gray forge	14.25 to 14.50

MORE HOPEFUL

Is Sentiment in Chicago District—Cast Iron Pipe Lower.

Office of THE IRON TRADE REVIEW,
1328 Monadnock Blk., Jan. 3.

The final week in the year, while very quiet in the Chicago market, showed under the surface some indications of improvement. Whether actual buying will improve to any great extent in the near future is yet a matter of conjecture, but sentiment at present is obviously more hopeful. This may be due merely to a more patient attitude toward prevailing conditions on the part of sellers and to a more general disposition to make the best of conditions. Estimates obtained from reliable sources indicate that the total sales of steel products in the Chicago territory during the last year were approximately 2,000,000 tons, a shrinkage of about 50 per cent compared with 1909. Shipments during the past 12 months, however, were nearly equal to those during the year preceding because a great deal of the heavy buying which was done during the latter part of 1909 was for delivery over 1910. The mills enter the new year with less business on their books than for many months. Competent authorities feel that in view of these conditions and the depleted state of stocks generally throughout the west, a heavy tonnage must inevitably be booked during the early months of 1911. Whether this expectation will be realized, remains to be seen.

Pig Iron.—Sales continue very light, although there is a little more iron under negotiation than was the case a week ago and there is no evidence of $11.00 for prompt shipment of southern iron being shaded. Sales are being made in driblets, however, and we note a purchase of 250 tons of southern No. 2 for prompt delivery to a Chicago foundry. We also note an inquiry for 200 tons of northern iron for prompt shipment. While attractive prices will be made for round tonnages of northern iron, the market is quotable $16.00, Chicago, for No. 2 at present, covering delivery throughout the first quarter.

Steel.—Specifications for steel bars are being received in fairly satisfactory quantities, particularly from implement manufacturers. There is considerable speculation regarding the possibility of prices being reduced, but the market is well maintained at present. Bars, plates and shapes are not quoted below 1.58c, Chicago, and the few mills which were quoting 1.53c on plates recently have apparently withdrawn these prices. Some slight evidence of railroad activity is shown in an order of 600 tons of bridge material taken by the American Bridge Co. from the Northern Pacific. The Milwaukee Bridge Co. has taken a contract for the Union avenue bridge, Pueblo, Colo., which will require 420 tons. Bids on the new Peoria bridge, 1,500 tons, which is to replace a concrete bridge that failed, have been opened and are now under consideration. Competition for track bolts and spikes is more keen and sales of standard track bolts with square nuts have been made as low as 2.15c in this market within the past week.

While the sales of standard rails during the past year were only about half those during the year before, the business in light rails has held up remarkably well, 1910 sales being only 3 per cent less than 1909. Orders for light rails continue to be received in fair quantities. One interest selling light rails in this market disposed of 62,000 tons in 1909 and 60,000 tons in 1910.

Lighter Finished Products. — The sheet situation remains practically unchanged, although heavier orders are expected during January, following the inventory period. Wire business is fair and wire mills are receiving good orders for the spring trade. Merchant pipe and tubes are quiet.

Cast Iron Pipe.—Competition for cast iron pipe business is becoming rather pronounced and nominal prices are being shaded. We note quotations of $24.25 for 4-inch water pipe and $23.25 for 6 to 12-inch pipe on a lot of 400 tons, for delivery in this vicinity until April. For delivery beyond April, $1.00 a ton additional is asked.

Scrap.—The scrap market remains dull and heavy with no price changes of consequence. Stocks of scrap in the hands of railroads are accumulating, which is adding somewhat to the pressure on the market.

The quotations are omitted from this report, but there have been no changes in prices of iron and steel products during the past week other than those noted above. A review of the Chicago market for the year 1910 and a table of average monthly prices will be found elsewhere in this issue.

Alfred Adam Corey Sr., father of W. E. Corey, president of the United States Steel Corporation, died Dec. 29 at the Corey summer home, Thorndale, Chester county, Pa., after having been in ill health for the past seven or eight months aged 72.

The Tuffli Bros. Pig Iron & Coke Co., St. Louis, has received word of the arrival at Honolulu of Vice President Richard Tuffli, enroute to the Orient to spend the winter.

The Country's New Blast Furnace Construction

Thirteen Entirely New Stacks Completed in 1910—Present Actual Commercial Capacity is About 33,000,000 Tons

By B. E. V. Luty.

Our annual review of blast furnace construction, of which this is the fourth number, is not a perfunctory work following predetermined lines, but is an effort to give the iron trade, so far as the writer's data and capacity to interpret permit, the information of which it stands in greatest need at the time the particular review is prepared. What is needed in some quarters at least in the trade today is assurance that the actual pig iron capacity of the country is not 38,000,000 or 40,000,000 tons, as has been erroneously inferred from last August's report of the American Iron and Steel Association. That report was misunderstood. It appeared at a time when the subject of capacity was of very special interest and hence the figures were taken up by many who usually pay little attention to such matters and have not fitted themselves to interpret these reports, which are made by the association at intervals and are of great value to those who know how to analyze and interpret them.

The commercial pig iron capacity of the United States is much less than the nominal capacity as reported. The latter is the sum of all the annual capacities reported by the various blast furnaces. The difference between actual and nominal capacities arises chiefly from three things:

(1) The furnace manager most familiar with his furnace cannot tell precisely how much pig iron he is going to be able to get out of it in the ensuing 12 months. There being a variation between statement and performance, it much more frequently takes the form of an overstatement than an understatement.

(2) When the annual capacity of a furnace is stated it is usually what the furnace is expected to do in a year in which it is not relined, but, broadly speaking, one-third of all the furnaces have to be relined in each year. Furthermore, there are always some accidents and other interruptions from physical causes.

(3) Furnaces are reported which are really incapable of running except possibly at ultra high prices.

We can prove what we say above very easily. Anybody will admit that the Allegheny county furnaces, the cream of the general Pittsburg district, are the most likely of any in the country to come up to their nominal ratings. They are all up to date in their way and, when demand in the country at large is good, they are sure to be under pressure. We are going to take the actual performance from Jan. 1, 1906, to July 1, 1907, when the whole country was running at its maximum possibilities, and that the Pittsburg district was under pressure then is very convincingly shown by the fact that several new furnaces were then being built. There were three half years of intense pressure, and the Allegheny county furnaces produced as follows:

First half, 1906	2,856,327
Second half, 1906	2,846,394
First half, 1907	2,851,098
Average	2,851,273

Outside of a very slight interruption by a flood in the spring of 1907, those furnaces simply made all the pig iron they could. The total ratings for the furnaces, however, ratings which helped to make up the nominal total under discussion, amounted to 6,172,000 tons, or 3,086,000 tons for a half year. Their very best performance was 7.6 per cent under the ratings at which they were being carried.

If this is the case in the heart of the Pittsburg district, who will deny that in the country at large, with detached old furnaces scattered through it, the total of nominal ratings may be 10 per cent or 20 per cent in excess of the average output which the furnaces can maintain under normal commercial conditions?

As we do not want to tell our story backwards, we leave the matter of developing what our actual commercial capacity really is until we have reviewed the year's contribution of new furnaces.

Thirteen New Furnaces in 1910.

In previous years, this review has not regarded a furnace as completed unless actually blown in. Conditions have changed; work has been in progress all year in the building of blast furnaces, but actual production has decreased continuously since February; to require a furnace to blow in to prove its being completed would be expecting a good bit, hence we insert in our list of completions several furnaces not actually blown in at the time.

The furnaces we consider are exclusively the additional furnaces which add a fresh number to the list; all rebuildings and replacements are excluded, unless the furnace replaced had been definitely abandoned and its number dropped. The new furnaces were as follows:

East Jordan Furnace Co., East Jordan, Mich.; charcoal, 60 x 10; ground broken Sept. 1, 1907; blown in Jan. 17, 1910; annual capacity, 24,000 tons.

Aliquippa No. 2; Jones & Laughlin Steel Co., Pittsburg; furnace at Woodlawn, Pa., 20 miles below Pittsburg; 90 x 22; 175,000 tons; blown in Feb. 14, 1910.

Gary No. 6; Indiana Steel Co., Gary, Ind.; 88 x 21½; 150,000 tons; blown in March 16, 1910; the seventh Gary furnace to be blown in.

Aliquippa No. 3; 90 x 22; 175,000 tons; blown in April 12, 1910.

Worth Bros. Co., Coatesville, Pa.; 85 x 18½; 120,000 tons; ground broken July 27, 1908; blown in May 10, 1910.

Gary No. 5; the eighth Gary stack to be finished; practically completed in May, 1910, but not blown in.

River Furnace No. 1; River Furnace & Dock Co. (Corrigan, McKniney & Co.), Cleveland; 83 x 20¼; 125,000 tons; ground broken April, 1909; blown in May 28, 1910.

Zug No. 2; Detroit Iron & Steel Co., Detroit; furnace on Zug Island; 80 x 18½; 100,000 tons; blown in about July 20, 1910.

Furnace C, Youngstown Sheet & Tube Co., Youngstown, O.; 88 x 22; 180,000 tons; blown in Aug. 16, 1910.

Wickwire Y, Rattlesnake Island, near Buffalo; Wickwire Steel Co., Buffalo, N. Y.; 85 x 21; 140,000 tons; blown in Oct. 1, 1910.

F and G, South Bethlehem; Bethlehem Steel Co.; 90 x 22; 140,000

tons each; practically completed in December, but not blown in. The Bethlehem company has had a total of seven numbered furnaces, the last of which was built in 1883. No. 3 was abandoned before 1890, No. 1 in 1895 and No. 7 (a detached furnace at Bingen), in 1897; thereupon the company had four furnaces. Its present program, adopted years ago, is that of building seven lettered furnaces, four of these replacing the four surviving numbered furnaces and three being new. Pursuant to the plan, it completed and blew in Furnace E, a new one, April 22, 1907; Furnace D and replacing No. 6, April 7, 1910, while F and G, new furnaces, were practically completed at the end of 1910, but not blown in. There were left of numbered furnaces, 2, 4 and 5, to be replaced ultimately by A, B, C. The new (and lettered) furnaces are 90 x 22.

Aliquippa No. 4; 90 x 22; 175,000 tons; completed at end of 1910 but not blown in.

Adding the above data to the table given a year ago, we have the following absolutely new furnaces completed in six years. The table contains four furnaces completed in 1910 but not actually blown in; it contains several furnaces, actually blown in during the fore part of 1905, which were practically completed in 1904 and could have been blown in during that year.

It will be observed from the summary of six years of new blast furnace erection that the independent steel companies lead the United States Steel Corporation by one in the number of furnaces built and by a small margin in aggregate capacity and percentage of total. The change occurred in the past year, for in the five years ending Dec. 31, 1909, the Steel Corporation completed 22 furnaces to 17 for the independents, the respective proportions of total being 44.7 and 34.5 per cent. The Steel Corporation has only two of the 13 new furnaces of 1910.

NEW FURNACES COMPLETED—1905-1910.

Date blown in. 1905.	Name of furnace.	Location.	Size.	Annual capacity.
Jan. 1	Pine Lake (Chl.)†	Boyne City, Mich.	60 x 10½	29,000
Jan. 3	Donora No. 1*	Donora, Pa.	85 x 22	150,000
Jan. 21	Lackawanna No. 4	Buffalo	94 x 24	180,000
Feb. 7	Donora No. 2*	Donora, Pa.	85 x 22	150,000
Feb. 22	Lorain D*	Lorain, O.	85 x 22	150,000
Apr. 28	Ensley No. 6*	Ensley, Ala.	87 x 27¾	100,000
June 23	Woodward No. 3†	Woodward, Ala.	85 x 20	90,000
July 5	Buffalo-Susq. No. 2†	Buffalo	80 x 20	113,000
Sept. 3	Lackawanna No. 5	Buffalo	94 x 24	180,000
Dec. 28	Monongahela C*	McKeesport, Pa.	90 x 22	150,000
	Total in 1905, 10 furnaces			1,292,000
1906.				
Jan. 17	Cambria No. 7	Johnstown, Pa.	85 x 22	150,000
Jan. 21	Mingo No. 4*	Mingo Junction, O.	90 x 21½	145,000
Mar. 6	Cadillac (Chl.)†	Cadillac, Mich.	60 x 12	40,000
May 1	Lackawanna No. 6	Buffalo	94 x 24	180,000
June 21	South Works E*	South Chicago, Ill.	90 x 22	160,000
Sept. 2	Joliet No. 4*	Joliet, Ill.	90 x 22	150,000
Sept. 3	Palmerton No. 2†	Palmerton, Pa.	70 x 14	20,000
Sept. 6	Midland†	Midland, Pa.	85 x 21	150,000
Oct. 3	Haselton No. 2	Youngstown, O.	85 x 19½	140,000
	Total in 1906, 9 furnaces			1,135,000
1907.				
Jan. 1	Haselton No. 3	Youngstown, O.	85 x 20½	150,000
Jan. 5	Toledo No. 2†	Toledo, O.	80 x 20	135,000
Jan. 14	Josephine†	Josephine, Pa.	80 x 20	140,000
Feb. 1	Federal No. 1†	South Chicago, Ill.	75 x 18½	110,000
Feb. 12	Lackawanna No. 7	Buffalo	85 x 22	180,000
Apr. 22	Bethlehem E	South Bethlehem, Pa.	90 x 22	140,000
May 2	Mayville B†	Mayville, Wis.	77 x 17	90,000
May 2	Minnequa F	Pueblo, Colo.	85 x 20	125,000
June 4	Carrie No. 6*	Rankin, Pa	85 x 22	160,000
June 16	Perry†	Erie, Pa.	75 x 17	100,000
Aug. 3	Carrie No. 7*	Rankin, Pa.	85 x 22	160,000
Aug. 7	Cambria No. 8	Johnstown, Pa.	85 x 21	150,000
Aug. 30	Madeline	Indiana Harbor, Ind.	85 x 19½	125,000
Sept. 26	Lorain E*	Lorain, O.	90 x 22	150,000
Oct. 10	Monongahela D*	McKeesport, Pa.	90 x 23	150,000
	Total in 1907, 15 furnaces			2,065,000
1908.				
Apr. 30	Vanderbilt No. 2†	Boyles, Ala.	80 x 18	80,000
June 30	Harvester No. 3	South Chicago, Ill.	90 x 21	140,000
Aug. 22	Miami†	Hamilton, O.	80 x 18	100,000
Oct. 4	Jisco (Silicon)†	Jackson, O.	75 x 17	28,000
Oct. 16	Wickwire X	Buffalo	80 x 20½	100,000
Nov. 2	Tube A	Youngstown, O.	88 x 22	180,000
Nov. 21	Ironton†	Ironton, O.	75 x 18	80,000
Nov. 23	Tube B	Youngstown, O.	88 x 22	180,000
Dec. 21	Gary No. 10*	Gary, Ind.	88 x 21½	150,000
Dec. 28	Gary No. 11*	Gary, Ind.	88 x 21½	150,000
	Total in 1908, 10 furnaces			1,188,000
1909.				
Jan. 15	Gary No. 12*	Gary, Ind.	88 x 21½	150,000
Feb. 11	Ohio No. 5*	Youngstown, O.	95 x 23	182,500
Mar. 17	Duquesne No. 5*	Duquesne, Pa.	95 x 22	182,500
June 13	Gary No. 9*	Gary, Ind.	88 x 21½	150,000
June 29	Ohio No. 6*	Youngstown, O.	95 x 23	150,000
July 14	N. Y. State	Buffalo	85 x 21	150 000
July 15	Federal B†	South Chicago, Ill.	80 x 20	125,000
Aug. 11	Duquesne No. 6*	Duquesne, Pa.	95 x 22	182,500
Sept. 20	Cleveland No. 2†	Cleveland	90 x 22	150,000
Nov. 20	Gary No. 8*	Gary, Ind.	88 x 21½	150,000
Dec. 1	Aliquippa No. 1	Woodlawn, Pa.	90 x 22	175,000
Dec. 4	Gary No. 7*	Gary, Ind.	88 x 21½	150,000
	Total in 1909, 12 furnaces			1,930,000
1910.				
Jan. 17	E. Jordan (Chl.)†	East Jordan, Mich.	60 x 10	24,000
Feb. 14	Aliquippa No. 2	Woodlawn, Pa.	90 x 22	175,000
Mar. 16	Gary No. 6*	Gary, Ind.	88 x 21½	150,000
Apr. 12	Aliquippa No. 3	Woodlawn, Pa.	90 x 22	175,000
May 10	Worth No. 1*	Coatesville, Pa.	85 x 18½	120,000
———	Gary No. 5*	Gary, Ind.	88 x 21½	150 000
May 28	River No. 1†	Cleveland	83 x 20¼	125,000
July 20	Zug No. 2†	Detroit, Mich.	80 x 18½	100,000
Aug. 16	Tube C	Youngstown, O.	88 x 22	180,000
Oct. 1	Wickwire Y	Buffalo	85 x 21	140,000
———	Bethlehem F	South Bethlehem, Pa.	90 x 22	140,000
———	Bethlehem G	South Bethlehem, Pa.	90 x 22	140,000
———	Aliquippa No. 4	Woodlawn, Pa.	90 x 22	175,000
	Total in 1910, 13 furnaces			1,794,000

*United States Steel Corporation furnaces.
†Merchant furnaces.

The distribution as to ownership of above furnaces is as follows:	No.	Capacity.	Percentage.
United States Steel Corporation	24	3,705,000	39.4
Independent steel interests	25	3,870,000	41.2
Merchant interests	20	1,829,000	19.4
Total	69	9,404,000	100.0

The Present Capacity.

As already observed in this article, the actual commercial capacity of the blast furnaces of the country cannot be learned with any approximation to accuracy by adding the rated capacities of all furnaces in existence. An admirable means for arriving at a close approximation is furnished through the fact that from late in 1904 to late in 1907 the furnaces of the country produced all the pig iron they could afford to produce, under the existing commercial conditions, which were extremely favorable. In our article of a year ago a table was given showing, by half years from Jan. 1, 1905, to June 30, 1907, the actual make, as officially reported, and the contributions of new furnaces blown in at intervals during the period. The difference gave the contribution of furnaces completed be-

fore Jan. 1, 1905, and those differences showed remarkable agreement.

As a basis, we took the actual output in the twelvemonth ended June 30, 1907, which was 26,202,985 tons. From this we deducted an estimate of 714,000 tons for the contribution of furnaces blown in at various times during that twelvemonth, leaving approximately 25,500,000 tons as the capacity July 1, 1906. In the second half of 1906 new furnaces were completed with 460,000 tons annual capacity, giving 25,960,000 tons at the end of the year. From that point we can carry the figures to the present:

	New in year.	Total at close.
Jan. 1, 1907		25,960,000
1907	2,065,000	28,025,000
1908	1,188,000	29,213,000
1909	1,930,000	31,143,000
1910	1,794,000	32,837,000

We can check the above figures to an extent. A capacity of 28,025,000 tons is shown at the close of 1907, and it is known that the furnaces did work up to an output of very close to 28,000,000 tons a year, in October, 1907. Again, a capacity of 31,143,000 tons is shown at the end of 1909, and it is known that the furnaces made at the rate of about 31,600,000 tons fr a short time early in 1910. It was claimed at that time, and with good show of reason, that many furnaces had been put in good shape during the off period, and if in the winter of 1909-10 there were a few furnaces idle which had physical and commercial possibilities, there were fewer furnaces than normal out of blast for relining and other repairs.

That the capacity of many furnaces has been increased by rebuilding is not questioned. There has been extensive work of that sort in the past few years, which does not get into this summary at all, but there is an issue only as to what has occurred since the period July 1, 1906, to June 30, 1907, the output in which time furnished the basis of the above computation. As we are interested in commercial capacity under present and prospective conditions, there is a counter influence which throws that one quite in the shade. In the 12 months ending June 30, 1907, the average price of pig iron at valley furnaces was as follows:

Bessemer	$21.00
Basic	20.66
No. 2 foundry	21.62

Present prices average almost precisely $7 per ton lower, and prices of pig iron in other markets have declined in much the same ratio, while prices of billets and finished products have also declined. Does anyone pretend to maintain that those declines have not put some furnaces so badly out of the running that an advance of several dollars a ton over present prices, giving comfortable profits to many furnaces, would not put them in again? Since the beginning of the blast furnace industry in the United States, furnaces have been falling by the wayside. Hundreds—we believe the number would really run into four figures—have had to be abandoned because they would lose money while surviving furnaces were making money.

No one is particularly interested in how much pig iron would be made were there unlimited supplies of ore and coke at low prices, and unlimited tonnages of pig iron could be sold at $20 or $30 a ton. What the industry is vitally interested in is how much pig iron can be made at present prices or at prices say 10 to 20 per cent higher.

That question we answer by saying about 33,000,000 tons.

A Dozen Furnaces in Prospect.

On account of the business uncertainty the prospects of new furnaces being completed at given times cannot be discussed with the certainty that has been possible in previous reviews. A year ago, there were summarized 16 furnaces as likely to come in during the first three quarters of 1910, and 12 of them really were completed in 1910, together with one not expected so soon. At the present time the new furnaces under construction or definitely projected are practically all included in the following summary:

Josephine Furnace Co., Josephine, Pa., a companion to No. 1, 80 x 20, 140,000 tons, likely to be completed in February, 1911.

Iroquois Iron Co., Chicago, two merchant furnaces decided upon in December, 1909.

Rogers-Brown Iron Co., two merchant furnaces at Buffalo decided upon in December, 1909.

American Steel & Wire Co., Central No. 4, Cleveland, authorized in December, 1909.

Minnesota Steel Co., building complete steel plant at Duluth, to include two furnaces.

River Furnace & Dock Co., Cleveland, building a second stack, No. 1 having been blown in May 28, 1910.

Worth Bros., Coatesville, Pa., building a second stack, No. 1 having been blown in May 10, 1910.

Republic Iron & Steel Co., completing Haselton No. 4, at Youngstown, to be blown in during the early months of 1911.

The Pittsburg Steel Co. contemplates building two furnaces to serve its open-hearth steel works at Monessen, Pa.

Several other projects have been discussed, but positive information is not available at the moment as to whether the furnaces will be built. Summarizing the above, with pure estimates as to capacity, we have:

Josephine No. 2	140,000
Haselton No. 4	150,000
Pittsburg Steel, two	240,000
Central No. 4	150,000
Minnesota, two	300,000
Iroquois, two	240,000
Rogers-Brown, two	240,000
Worth	120,000
River No. 2	120,000
12 furnaces	1,700,000

To the 33,000,000 tons we have already given as the reasonable commercial capacity under price conditions approaching the present, we may add 2,000,000 tons, including the above 13 furnaces and the rebuilding and improving of other furnaces, striking 35,000,000 tons as the ultimate capacity to which the country is working under present conditions. The majority of the furnaces listed above are not likely to be completed before the second half of this year.

The Cornell Receivership

At a meeting of the creditors of the J. B. & J. M. Cornell Co., New York City, structural iron and steel contractor, A. Gordon Murray, one of the receivers, was appointed trustee, with a bond of $50,000. Mr. Murray made a statement showing assets of $496,074. There are liabilities consisting of receivers' certificates, $200,000; bills payable on Dec. 1, $97,506, and when the receivers took possession they were charged with $200,000 book value inventory, but it is doubtful if they were made to realize scarcely anything. Mr. Murray said that he had not seen any profit on contracts except one. All but one of the contracts are on the New York state barge canal work on which is now suspended because of the winter season. He believed it would be best to close up the contracts at the best terms and make a quick liquidation. Negotiations are now under way with other contractors to take this work off the receivers' hands.

The Mangum Electric Co., Mangum, Okla., was incorporated last week with a capital of $200,000 and is soliciting bids for electrical machinery of all kinds.

Record Year for Imports of Foreign Ore

The Increased Cost of Lake Superior Ores Narrows the Zone in Which They Are the Most Important Factor

By Cas. J. Stark.

In a time of unsatisfactory conditions of trade such as now prevails in the iron and steel industry of the country, some noteworthy policies that have been adopted by producers in their unceasing efforts to cut into their cost sheets and to fortify themselves upon their raw material requirements, frequently fail to attract the deserved measure of attention and occasion no more than a passing thought. It seems fitting, therefore, that some emphasis be laid upon the statement that the year 1910 will show the greatest total of imports of iron ore to the United States from the mines of foreign countries in the history of the industry. Estimates in which are included official figures of the ore receipts at the different ports for ten months of the year place the movement at between 2,600,000 and 2,700,000 tons, an increase of about 900,000 tons over 1909, which was the previous largest year.

This proportionately large gain in foreign shipments, by necessity of geographical position, has applied wholly to the eastern branch of the iron and steel industry of this country. Limited further, it has been of direct importance to those steel and blast furnace interests whose plants are located within a relatively short freight haul from the Atlantic seaboard. This territory embraces the iron-producing districts of New Jersey, Eastern Pennsylvania and Maryland, including in all probably 60 blast furnaces.

The conditions that have preceded this drawing upon the ore fields of Canada, Cuba and trans-Atlantic countries, have had mainly to do with the domestic ore market. The repeated advances in Lake Superior ores have steadily diminished their practical importance in liberal use to the eastern furnace operator because of his far-removed location. The local eastern deposits being relatively small and altogether inadequate to meet full needs. the eastern operator has been obliged to look about for a new base of supplies that would contribute to a greater security in his manufacturing operations. His geographical position and the favorable prices prevailing on foreign ores have attracted his attention in that direction. As has been pointed out before, the reduction of the ore tariff from 40 to 15 cents a ton, has been only a contributing rather than a main factor in stimulating such action because this reduction has been largely absorbed in the prices quoted by sellers, but it has operated to make the market in the eastern district more attractive from the standpoint of the foreign miner. Experiments with such ores having brought satisfactory results, the eastern iron maker has steadily increased his purchases of these at the expense of lake ores, so that only meager quantities of the latter grades have been used the past year in the furnace operations of the eastern territory.

The total foreign ore movement of the year, while the largest in history, still falls considerably below the tonnage that it had been expected would be brought in. The unfavorable condition of the pig iron market, especially over the final half of the year, causing the blowing out of many furnaces in eastern territory, led to a considerable restriction in the deliveries of ore from the total tonnage originally specified in the season's contracts. Shipments on more than 200,000 tons of different ores were deferred at the requests of the purchasers, including 100,000 tons of Swedish, 75,000 tons of Wabana, Newfoundland, and 75,000 to 100,000 tons of Spanish ore. Owing chiefly to unsatisfactory physical characteristics which developed in the use of some ores, a number of cancellations of contracts were made. Some of the ores proved to be of too fine a quality to produce expected yields under common eastern furnace practice and these difficulties pertaining largely to certain Spanish grades caused the rescinding of contracts for probably 150,000 tons. These cancellations and postponements of deliveries make it certain that had trade activity in 1910 prevailed in the degree early expected, the total foreign ore shipments in the year would have reached or passed the predicted estimates of 3,000,000 tons.

The estimated total foreign ore movement for 1910, which includes official figures of receipts at the ports of Philadelphia and New York and of Baltimore in part for the first ten months of the year, is as follows:

Cuba	1,500,000
Spain	450,000
Sweden	300,000
Canada (including Newfoundland)	235,000
Greece	40,000
Africa	25,000
Miscellaneous	60,000
Total	2,610,000

These imports were divided among the three principal receiving ports as follows:

Philadelphia	1,365,000
Baltimore	1,160,000
New York	85,000
Total	2,610,000

These figures do not include the imports of manganese ore brought in at Baltimore from Russia and India by the United States Steel Corporation. Such shipments were probably 50,000 tons.

In 1910 the total foreign ore imports were 1,694,937 tons, of which Philadelphia has received 991,983 tons, Baltimore 628,577 tons and New York 47,285 tons.

The prices at which foreign ores have sold in the east this year have ranged from 7 to 9 cents per unit of iron, ex ship, Philadelphia. The lowest figure has applied chiefly to trial lots of the leanest and siliceous grades, as the better ores have sold around 7½ to 8½ cents a unit loaded in cars at Philadelphia. The cost of delivered foreign ore to the principal consumers in eastern districts, has been from less than 1 to about 1½ cents per unit above the seaboard price, as the furnaces which have been following such mixtures are located within a freight radius of about 75 cents per ton from Philadelphia, while to some plants the rate is as low as 35 cents per ton. By way of comparison, Mesabi non-Bessemer ore at the present price of $4 per ton for 51½ per cent iron content, at Buffalo, the nearest lake port, cannot be delivered in the same territory at a cost of less than 10½ cents to the furnace. The use of foreign ore, therefore, nets the eastern furnace operator an econ-

omy of from 1 to 2 cents per unit of iron.

Cuba Gains Heavily.

Cuban operations have expanded in a considerable degree this year and for the first time have passed the million mark. The shipments of the principal producer of that territory, the Spanish-American Iron Co., this year have approximated 1,050,000, as compared with 524,949 tons in 1909, its largest previous year. In addition to the tonnage taken from its own properties, the company brought about 100,000 tons from the deposits of a private interest, the operations of which are located near Daiquiri. Development work on the north coast has been more extensive this year than ever before and during some months fully 50 per cent of the total shipments brought to this country were from these mines. All the ore of the Spanish-American Iron Co. is brought in at the port of Baltimore and from there directed to the blast furnace plants of the controlling companies, the Maryland Steel Co. at Sparrow's Point, Md., and the Pennsylvania Steel Co., at Steelton, Pa. To provide the necessary handling facilities for the increased tonnage of ore being mined and transported, extensive improvements in the form of the installation of modern ore docks and trestles of increased capacity were made this year at Sparrow's Point. The estimated shipments of the second leading Cuban ore company, the Juragua Iron Co., which were about 350,000 tons, are slightly below those of the previous year. In that period, the record movement of the Cuban ore in the company's history amounted to 389,926 tons. As is commonly known, this ore goes to the furnaces of the Bethlehem Steel Co., at South Bethlehem. The Juragua Iron Co. is a subsidiary of the Bethlehem Steel Corporation. By reason of the fact that the port of Philadelphia is the most favorably located with respect to the final destination of the ore, practically all the shipments of the Juragua Iron Co. are brought in at that point and handled at the Port Richmond docks.

The Swedish Movement.

Swedish ore has enjoyed a greatly increased adoption the past year in the mixtures of eastern furnaces. The total importations of the year from that country are estimated at about 300,000 tons, or more than double those of the preceding year, which had witnessed the first use of Swedish ore in this country on an important scale. Swedish ore was actively offered for sale in this country for the first time in 1909 and the initial cargo of the present movement came in February of that year. Since then about 525,000 tons of the ore fields of the Kiirunavaara and Loussavaara, Lapland, have been purchased by eastern pig iron makers. At the close of 1910, all but about 100,000 tons of this aggregate had been delivered to consumers and the remainder approximates the amount upon which shipments were deferred until next year by agreement of seller and buyer because of the scaling down of furnace operations. The rich iron content, which sometimes runs as high as 67 per cent, and its suitable analysis generally, and the favorable price at which it was sold have made Swedish ore this year a very desirable material for the eastern furnacemen and it has come in freely during most of this period. The shipments of this ore are made from Narvik, Norway, and Lulea, Sweden, and are less subject to the interruptions of the freight market, since they are made to this country in the ships of a transportation subsidiary of the seller and miner, the Trafik Aktiebolaget Grangesberg-Oxelosund of Stockholm. During November, there came to this country, on its maiden trip, the Sir Ernest Cassel, a new vessel especially designed for the transportation of ore over long distance, and equipped with its own unloading and handling devices. This boat has a rated capacity of about 11,000 tons.

Increased Canadian Shipments.

Canadian shipments in the year also established a new high record. The great bulk of this ore came from the Wabana, Newfoundland, deposits, which for the past five years have been supplying ores in considerable quantities to the eastern district. The movement from this source in the year was approximately 220,000 tons, out of total sales for the season of about 300,000 tons. The difference between these figures represents the deferments granted on contracts. From other Canadian operations about 15,000 tons were brought in, but these were principally in trial cargoes of relatively lower grade ores and were chiefly from new workings at Bathhurst, New Brunswick, and Annapolis, Nova Scotia.

The Spanish movement this year is more extensive than ever before, reaching approximately 450,000 tons, and this country retains the leadership of furnishing the largest quantities of foreign ore for merchant pig iron operations in the country.

The Freight Problem.

The movement of foreign ore on an extensive scale to the furnaces located nearby the eastern seaboard of the United States, has apparently come to stay as a prominent feature of that division of the industry, but there are conditions incident and peculiar to this traffic which apparently will, in a measure, retard its growth to great proportions. This is especially true as to the shipments of trans-Atlantic ore. Of leading importance among these factors that bear upon the situation, are the sharp fluctuations that characterize the ocean freight market. This condition is well illustrated by the experience of the past year. At the beginning of 1910 and at the time when a basis of computation as to freight margins was sought in the fixing of the season's ore prices, delivered seaboard, charters ruled about 8s 6d from Mediterranean ports to Philadelphia. On several occasions during the year, chartering was done at 10s 6d and near the beginning of 1911 the quotable range of rates was from 10s to 10s 6d. During practically all of the year, freights from southern European ports have been higher than 9s and have been well around 9s 6d. This problem is one purely of supply and demand as regulated by the physical position of the ships at the time of the offering of cargoes. The shipmaster in his chartering from port to port naturally follows the most profitable avenues that are open to him in the transportation of various articles in the inter-continental trade. This often necessitates his boats being diverted from the regular movement between Mediterranean ports and the United States, which temporarily places the vessel in the unavailable class as an ore carrier. Such conditions restrict the supply and rates consequently advance under the offering of any considerable tonnage. At times the supply of boats is relatively free and at others extremely scarce and these conditions cause the market to vary almost with individual charters. The state of the export trade of the United States and Southern Europe or to ports which would place suitable vessels in the position for taking ore cargoes has not been especially inviting the past year to ship owners. Having brought in an ore cargo, these masters have some times been obliged to wait for days for the return cargoes

with the consequent reduction of prices. The result has been that higher rates have been asked on the original shipments to cover such contingencies. One of the leading shippers of Spanish ore, to meet these conditions, found itself obliged to acquire a fleet of vessels and to accept contracts for delivery of American coal to French ports. This was done, not only to provide return cargoes, but to bring the ships back into the zone from which the ore shipments are originated.

This Year's Outlook.

For the first time in many years, tramp ships are getting profitable employment the world over, freight conditions having improved on an important scale. As a consequence, any important sales of foreign ore now made for next year's delivery impose a considerable risk upon the seller. The effect of this instability of the freight market has been to make ore sellers more cautious to name attractive prices laid down at eastern seaboard, which contemplate the absorption of an average freight cost. This is a problem peculiarly a portion of the seller's risk, since foreign ore is quoted at a delivered price in cars at seaboard points. A wider allowance made for the freight charge will have the effect of increasing the cost of foreign ore to eastern furnaces. There were indications at the close of the year that this problem of freights would exert considerable bearing upon the fixing of prices for next season's delivery and there were some evidences of increases likely to be named. It is questionable whether prices which were made at the best selling periods of 1910 could now be repeated for 1911.

Another factor that has some influence upon the offerings and prices of foreign ore to this country, is the state of the iron and steel industry in Great Britain and Continental Europe. The British Isles, Germany and Belgium draw heavily upon the Spanish, Swedish and other European and African ore districts and when trade conditions in these consuming countries are active, the supply of ore that is offered for United States export is reduced.

Eastern Domestic Developments.

The gradual elimination of Lake ores from the mixtures of a number of the eastern blast furnaces has also brought with it some stimulus to the development of domestic ore properties in New York and New Jersey. In the Port Henry district, the largest domestic operation, that of Witherbee, Sherman & Co., Inc., in the year completed at Mineville what is probably the largest and most modernly equipped iron ore concentrating plant in this country. The capacity of this plant is from 850 to 1,500 tons per day of ten hours, varying according to the leanness of the ore and the fineness of grinding required. This operator has been pushing developments upon the Barton Hill property at Mineville, where tunneling is being followed, and the proving work done indicates that the ore body is a large one. The Port Henry Iron Ore Co. completed its new shaft, known as the Clonan shaft, which is near the Joker shaft of Witherbee, Sherman & Co. The mine of the Cheever Iron Ore Co. in the Port Henry district is now producing regularly under the operation of the Bethlehem Steel Co., which acquired it in 1909. The latest developments in the Port Henry field were covered in detail in The ron Trade Review of Aug. 4, 1910. In the Herkimer district of New York, the comparatively new operations of the Salisbury Iron & Steel Co. have continued as a shipper this year, but the output has not been large. Continued improvements to this property are in contemplation. The Benson mines at Benson Mines, N. Y., were indefinitely suspended because of cancellations of shipments due to the depressed trade conditions. In New Jersey, one of the most important developments has been with the large body of magnetite ore upon the properties of the Empire Steel & Iron Co. in the territory surrounding Oxford, N. J. The operations of the Washington mine there have been thoroughly modernized so that an average monthly capacity of about 10,000 tons is now being obtained.

Changes in Officers

Several changes in the officers of the Haskell & Barker Car Co. were made at a reorganization meeting held Dec. 22, at Michigan City, Ind., where are located the offices and plant. W. J. McBride, who was vice president and manager, was chosen president, filling the vacancy caused by the death of President John H. Barker. Louis Boisot, trust officer of the First Trust & Savings Co., Chicago, was elected secretary. Other officers are: Treasurer, Charles Porter; auditor, S. J. Taylor. The announcement is made that Herman Pries will remain as superintendent.

PIG IRON AVERAGES

For December Show Slight Changes—Some Quiet Negotiating.

Pittsburg, Jan. 4. (By wire.)

In some quarters consumers of pig iron are quietly negotiating for their first half requirements, although the market is not showing a great deal of life. Negotiations are pending for approximately 10,000 tons of iron for first half delivery, including 5,000 tons of Bessemer and two lots of malleable, one for 3,000 tons and another for 2,000 tons. A sale of 100 tons of malleable for immediate shipment at $13.50, valley, is noted. Conflicting reports are being circulated regarding the price of foundry iron, and notwithstanding reports of price concessions of 50 cents a ton, sales have been made this week at $14, valley, for first half.

The monthly average price of Bessemer pig iron for December was $15, valley, or $15.90, Pittsburg, the same as for September, October and November. The average price of basic for December is given as $13.466, valley, or $14.366, Pittsburg, as compared with $13.363, valley, or $14.263, Pittsburg.

Death of Reese James

Reese James, aged 61, superintendent of the open-hearth department of the Homestead works of the Carnegie Steel Co., died Dec. 30, at his home at Munhall, Pa. Mr. James was born in Wales and came to this country at an early age. After spending a few years at Johnstown, Pa., and Pueblo, Colo., he went to Braddock, Pa., where he entered the service at the Edgar-Thomson Steel Works. In 1892 he was made superintendent of the structural department. In 1902 he was made superintendent of the Bessemer department of the Carnegie Steel Co., at Homestead, Pa., and three years later was made superintendent of the open-hearth department.

R. C. Coombs, who for many years has represented the Stark Rolling Mill Co. and the Berger Mfg. Co., in Chicago, has resigned to become connected with the Inland Steel Co., with offices in the First National Bank building, Chicago, effective Dec. 31. He will care for the city trade, the northern part of the state of Illinois and the state of Iowa.

Napier Iron Co., Chattanooga, Tenn., expects to relight its furnace about Feb. 1. The stack is now being relined.

THE IRON TRADE REVIEW

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THE AVERAGE PAID CIRCULATION OF THE IRON TRADE REVIEW FOR THE ISSUES OF THE FOLLOWING MONTHS WAS:

January, 1910	5,681
February	5,703
March	5,754
April	5,793
May	5,827
June	5,842
July	5,864
August	5,875
September	5,895
October	5,955
November	5,993
December	6,026

January 5, 1911

A Record Year for Tonnage and Disappointments

The year 1910 will stand better in the statistics to be scanned in the future than it stands now in the minds of those who have just been experiencing its doubts and disappointments.

A new tonnage record in iron and steel production was easily made, as pig iron production exceeded 27,000,000 tons, against the previous record of 25,795,471 tons, made in 1909. In steel production, there was probably a gain of a million tons or more over the record output of 23,995,021 tons of ingots and castings, made in 1909.

By the chance of the calendar, the year 1910 arrived just before the iron trade had reached its highest point in production and just after it had reached its highest point in buoyancy. Thus we find the years 1909 and 1910 compare altogether differently, according as one measures by market tone or by production. From late spring until the close of 1909, the market tone improved. In 1910, it continually lost. Production reached its high point in February, 1910, and as it declined less rapidly than it advanced, the calendar year 1910 showed a materially larger production than did 1909. As to market tone, 1909 was by far the more satisfactory year; as to production, 1910 was easily the larger.

Disregarding the artificial limits of the calendar, the really good year in the iron trade was that from July 1, 1909, to July 1, 1910. In that period there was produced no less than 29,785,517 tons of pig iron, according to the official statistics, this exceeding by 4,000,000 tons the best calendar year record, and by more than 2,600,000 tons the best output in any consecutive 12 months, which was in the twelvemonth ended Oct. 31, 1907.

Throughout the year, prices of iron and steel showed a declining tendency, but the declines were by no means uniform. Pig iron declined rather rapidly and steadily until the close of August, but very slowly thereafter. Finished steel products declined very slightly until about the middle of May, while from then until the beginning of August the decline was fairly rapid. In August and September, very slight declines occurred, and in the fourth quarter there was practically none. Indeed, the closing weeks of the year were marked by the disappearance of some shading which had been noteworthy in September and October.

Southern pig iron declined about $3 a ton during the year, and the various grades of northern iron from $3 to $4. The relatively smaller decline of southern iron was due simply to the fact that its decline began in November of the preceding year, practically a dollar being lost in that year, while northern iron experienced no noteworthy decline until the early part of January, 1910.

Finished steel products may be divided for purposes of comparison into three classes: Standard sections of steel rails and tin plates, which did not decline at all; merchant pipe, which experienced widely different declines in the different sizes and descriptions, and plates, structural shapes, bars, hoops, wire products and sheets, which declined from $2 to $4 a ton, the average being approximately $3 a ton. In all cases, these declines were from the highest points reached in the recent movement.

But the course of the iron and steel market in 1910 is well known to all, and the general feeling no doubt is the less said about it the better. A study of the causes is of more interest, for thereby light may be thrown upon the future. Many men have many minds, but it is probable that all will unite in regarding as the three chief causes of the continued decline in prices and production in 1910 the political conditions, the railroad rate controversy and the overdoing of the recovery in 1909. If these are the three chief causes there is ground for much hope, if not actual confidence. The political situation has improved, for, with a divided congress, there will be no very radical legislation. As to the railroad rate controversy, orders may have been held up, but traffic has continued and the wear and tear means an accumulation of business. The railroads, moreover, have not in recent years taken more than 30 to 35 per cent of the total product of the iron industry, against 60 per cent in the old days, and even to cut their orders in half means much less loss than formerly. If the reaction came partly because the recovery in 1909 was overdone, there is reason to be-

lieve we have now swung too far downward, as we swung too far upward a year ago, and conditions should soon begin to rise to the normal.

A word needs to be said in regard to the spread between our productive rate and our capacity. The gap is not nearly so large as is assumed in some quarters, where the statement of blast furnace capacity made last August by the American Iron and Steel Association has been misunderstood. That statement showed a prospective nominal capacity on Jan. 1, 1911, of 38,873,400 tons, and Jan. 1, 1912, 40,228,400 tons. These figures, however, as was carefully pointed out in THE IRON TRADE REVIEW of Sept. 8, 1910, represent simply the sum of the estimates of individual furnace repairs, incomplete elimination of furnaces really unfit for ordinary competition and, generally speaking, no allowance for the leaner ores now used. Practical men who have studied the figures estimate an allowance of 15 per cent from the nominal capacity to obtain the real capacity, and with this allowance the capacity shown becomes 33,000,000 tons for Jan. 1, 1911. By an entirely different study of blast furnace performance, our annual review of blast furnace erection, printed elsewhere in this issue, finds a commercial capacity for the same date of 32,837,000 tons. The gap between that and the 30,000,000 tons actually made in a recent twelvemonth is not formidable.

From Iron Ore to Scrap

The publication in this issue of the first of a series of articles to be entitled "The A B C of Iron and Steel," marks the first public step in the carrying out of a plan which has been long in maturing in the office of THE IRON TRADE REVIEW. For years we have realized that there has never been published a book or series of articles which will give a man in the iron trade a comprehensive knowledge of the mining and manufacturing processes connected with the making of iron and steel without going into details which it is not necessary for the average business man to master. It is not even possible to make a collection of books which will give this information in simple form. A steel manufacturer will have no difficulty in finding learned books on steel manufacture, and nearly every branch of manufacture has its volumes that are highly creditable to the authors. The question that presents itself to many young men is, however, how can I get a general knowledge of the business within a reasonable time? Often we have been asked this question and been compelled to answer it in an unsatisfactory way to the inquirer. For example, if a pig iron salesman wanted to know about blast furnaces it would be easy to refer him to several who have written upon that subject. But if he wanted to know about iron ore mining and the manufacture of finished product, he would have difficulty in getting the desired information in the form adapted to his needs. Even some of the few recent books dwell upon details of chemistry, tests and other subjects about which many men in the trade do not care. Hence, we have conceived the idea of publishing a series of articles, which, while written in popular form devoid of dry details, will be by high authorities, will be absolutely accurate, and will give an excellent birdseye view of the whole business, from iron ore to scrap. These articles will be so written that anyone who has a public school education can understand them. We commend them to our readers, and earnestly request that criticisms be made, so that editors and authors may avail themselves of any suggestions that may be offered.

Our Annual Chart

The chart which accompanies this issue as a supplement shows fluctuations in prices of iron and steel products for the last sixteen years. The figures on which the chart is based are the average weekly prices given in the market reports of THE IRON TRADE REVIEW. They are computed for the following: Tank plates, Chicago; beams, Pittsburg; bar iron, Cleveland; Bessemer billets, Pittsburg; Bessemer pig iron, Pittsburg; No. 2 foundry, Chicago; gray forge, Cincinnati; No. 2 foundry, Birmingham; steel bars, Pittsburg.

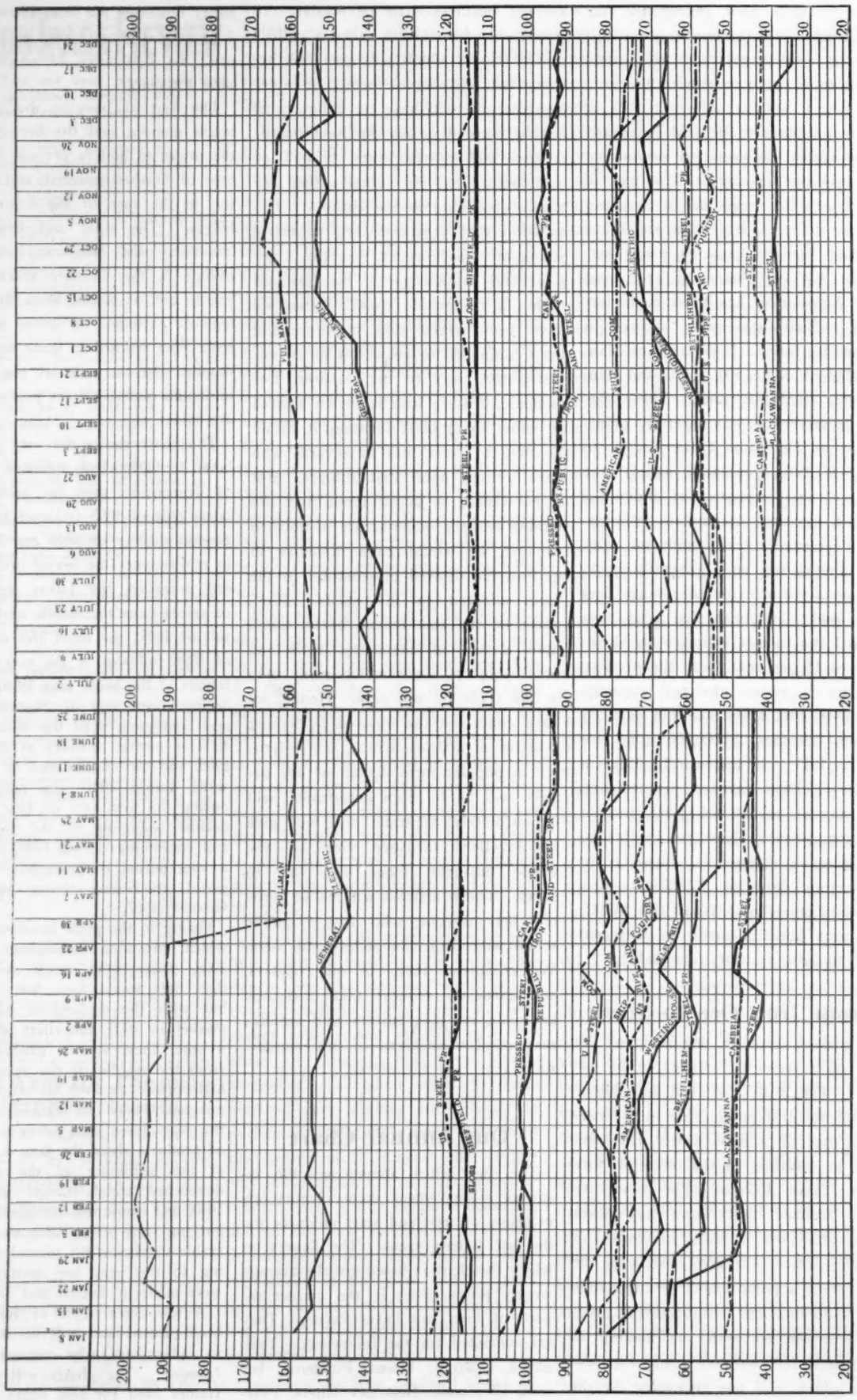
The vertical lines in the chart represent months, and the horizontal lines the prices in dollars per net ton in the case of finished material, and per gross ton in the case of pig iron and steel billets. The solid and broken lines traversing the diagram indicate the change in the monthly average prices, but do not, of course, show the extreme high or extreme low prices which may have been reached in some week of the month. In the case of pig iron, the minimum quotations for prompt delivery are taken.

The chart shows the very short-lived boom in 1895, which followed the period of depression; then the decline in the latter part of 1895 followed by the slow general decline of 1896 and 1897, when in mid-summer the lowest prices on record prevailed, the rather steady trend of prices from the middle of 1897 to the fall of 1898; the rapid rise at the close of 1898 followed by the very high quotations of the boom year 1899; the sharp decline beginning in September, 1899, and continuing until the midsummer of 1900; a partial recovery at the close of 1900, and the continuance of prices upward during 1901; the rapid advance during the first half of 1902 and sharp decline beginning in the fall of 1902 and continuing during 1903, followed by a long period of prosperity with occasional recessions, ending suddenly in October, 1907.

Owing to the price maintenance policy which prevailed throughout the year 1908, prices were much more regular than they would have been without it, but with the declaration of the open market in 1909, the chart shows a dip in the lines, and a gradual recovery from the middle of the year. But the high prices attained in other years of prosperity were not reached in 1909, and the year closed with prices on a number of products about the same as they were at the beginning of the year. The downward trend started in February, 1910, and continued throughout the year, but pig iron prices have shown considerable steadiness for several months, owing to the very low quotations which were made in August and September.

A few extra copies of the chart have been printed and will be sent in tubes to subscribers who request them for framing. The charts will fit into the frames used for past years.

FLUCTUATIONS OF LEADING INDUSTRIAL STOCKS IN 1910



Financial Review of the Year Just Closed

Many Commercial Records Broken—Huge Mass of New Securities Clogged Halting Banking Machinery—Liquidation Still in Progress

The year 1910, marked by a steadily declining share market from the opening which paralleled a receding iron and steel trade, was only a step toward inevitable readjustment of results of the panic year 1907. Partial obstruction to this readjustment had been worked in 1908 and 1909 by "sunshine leagues," etc., but it is now believed by the best authorities that substantial progress toward a real recovery is being made. Further, economic authorities hold, it was impossible for 1910 to have been other than it was because of the further accumulation of a great mass of "undigested securities" dumped upon unappreciative markets in every financial center of the world, a continuation of the dumping process of the last six months of 1909.

In the United States alone over $1,000,000,000 worth of such emissions were noted in the first half of 1910, and even this tremendous amount was exceeded in London. So, when railroads and other like borrowers found early in the spring the impossibility of marketing enough securities to finance proposed new work and needed repairs they cast about for other means. Railroads chose the method of increasing freight rates. Very elaborate schedules containing the new rates were filed, but their enforcement was stopped by government injunction until the justice of such a course of procedure can be determined. This is now in course of determination, the final decision of the interstate commerce commission to be made public in February. Since the filing of the government injunction, superficial students of economics have ascribed the accompanying liquidation of the share markets and halting business to this government action as well as the government suits to dissolve two large corporations. The more discerning, however, point to the heaping of new capital issues upon world-wide unsatisfactory money markets as the real underlying cause for uncertainty, combined with various local complications such as solutions now in progress and in prospect for various political problems not only in the United States, but also in England, France, Portugal, Spain, Turkey and other European countries, as well as a general social unrest in each of the countries named.

While the prices of some commodities receded slightly in 1910, yet the London *Economist's* index figure for Dec. 1 was 2,461, the highest for the year, which began with the figure 2,390, and the highest since Sept. 1, 1907. The year just closed broke all previous records in the country's money supply, national bank circulation, loans by the national banks, monthly bank clearings, monthly exports of merchandise, monthly imports, and total amount of interest and dividend disbursements. Seven railroads were thrown into receiverships, compared with five in 1909, but mileage and capitalization affected were much smaller than were involved in 1909.

More new main-line railway was laid last year in the United States, 4,122 miles, than in 1909, 3,748 miles, and in 1908, 3,214 miles. Commercial failures for the year were 12,637, compared with 12,807 in 1909; but the liabilities in 1910 were $199,607,292, compared with $151,752,093 in 1909.

Stock transactions on the New York exchange totaled 165,331,748, the smallest in six years, comparing with 215,198,510 shares in 1909, and 196,412,754 in 1908. Bond sales amounted to $645,703,000 for the year, compared with $1,306,329,000 in 1909, and $1,087,745,000 in 1908 and $527,436,000 in 1907.

	Closing Dec. 31, 1909.	Closing Dec. 31, 1910.	Changes in 1909.	†† At present price.	Basis.	Dividend Last Dividend	Dividend Date Last Div. Pay.
Allis-Chalmers	15¼	8	— 7¼	....		.....	.....
Allis-Chalmers, pr	55	29	—26	....	7 cum.	1¾ Q.	Feb., 1904
American Can	13¾	8⅝	— 5⅛	....		1¾ Q.	.....
American Can, pr	81	77½	— 3½	9.1	7 cum.	1¾ Q.	Jan., 1911
Am. Car & Fdy	72½	50¾	—21¾	1.0		½ Q.	Jan., 1911
Am. Car & Fdy., pr	120	114⅝	— 5⅜	6.1	7. n. c.	1¾ Q.	Jan., 1911
American Loc	61¾	38½	—23¼	....	5	1¼ Q.	Aug., 1908
American Loc., pr	115	108	— 7	6.5	7 cum.	1¾ Q.	Jan., 1911
American Ship	78	75	— 3	1.3	4	1 Q.	Sept., 1910
Amerioan Ship, pr	111½	111	— ½	6.3	7 cum.	1¾ Q.	Jan., 1911
Am. Steel Foundries(new).	65	43⅝	—21⅜	2.7		1¼ Q.	Nov., 1910
Barney & Smith	40	20	—20	....	4	1 Q.	June, 1908
Barney & Smith, pr	115	85	—30	9.4	8 cum.	2 Q.	Dec., 1910
Bethlehem Steel	34	29	— 5	....		.....	.....
Bethlehem Steel, pr	66	59	— 7	....	7 n. c.	¾ Q.	Feb., 1907
Cambria Steel	49	42½	— 6½	11.9	5	1½ Q.	Nov., 1910
Cambria Iron	47	45	— 2	4.4	4	2 S. A.	Oct., 1910
Chicago Pneumatic Tool	39½	41⅞	+ 2⅜	9.5	4	1 Q.	Jan., 1911
Colorado Fuel	49⅞	31⅛	—18¾	....		1¾ Q.	Apr., 1902
Crucible Steel	18¾	12¼	— 6½	....		3½.	.....
Crucible Steel, pr	93⅝	74⅞	—18¾	9.5	7 cum.	1¾ Q.	Dec., 1910
Empire Steel	15	7	— 8	....		.....	.....
Empire Steel, pr	80	51	—29	7.8	6 cum.	2 S. A.	Jan., 1911
Fay & Egan	95	70	—25	....	6	3 S. A.	Feb., 1909
Fay & Egan, pr	120	115	— 5	6.1	7 cum.	1¾ Q.	Nov., 1910
General Electric	159½	151	— 8½	5.3	8	2 Q.	Jan., 1911
Harbison-Walker	35	32¼	— 2¾	6.3		½ Q.	Dec., 1910
Harbison-Walker, pr	94½	94	— ½	6.4	6 cum.	1½.	Oct., 1910
International Pump	52⅝	40¼	—12⅜	10.0		1 Q.	Nov., 1910
International Pump, pr	90¼	85	— 5¼	7.1	6 cum.	1½ Q.	Nov., 1910
Lackawanna Steel	64	35	—29	....		.....	.....
Lake Sup. Corp	28⅛	29	+ ⅞	....		.....	.....
New York Air Brake	95½	75	—20½	8.0	8	1½ Q.	Jan., 1911
Niles-Bement-Pond	104	98	— 6	6.1	6	1½ Q.	Dec., 1910
Niles-Bement-Pond, pr	104	104	.....	5.8	6 cum.	1½ Q.	Nov., 1910
Otis Elevator Co	55	48	— 7	6.3	3	1½ S. A.	Oct., 1910
Otis Elevator Co., pr	99	97	— 2	6.2	6 n. c.	1½ Q.	Jan., 1911
Pa. Steel	65	60	— 5	....		.....	.....
Pa. Steel, pr	115	104	—11	6.7	7 n. c.	3½ S. A.	Nov., 1910
Pittsburg Coal Co	27⅜	17	—10⅜	....		.....	.....
Pittsburg Coal Co., pr	84	68½	—15½	10.3	7 cum.	1¾ Q.	Jan., 1911
Pressed Steel Car	51¾	30	—21¾	....		1 Q.	Aug., 1904
Pressed Steel Car, pr	106	93	—13	8.6	7 n. c.	1¾ Q.	Nov., 1910
Pullman	193	159	—34	5.1	8	2 Q.	Nov., 1910
Railway Stl. Spring	51⅞	32	—19⅞	....	2	1 S. A.	Oct., 1908
Railway Stl. Spring, pr	106¾	91¾	—15	7.6	7 cum.	1¾ Q.	Dec., 1910
Rep. Iron & Steel	46	30½	—15½	....		.....	.....
Rep. Iron & Steel, pr	104¼	92½	—11¾	7.5	7 cum.	1¾ Q.	Jan., 1911
Sloss-Sheffield	87	49¼	—37¾	....	5	1¼ Q.	Sept., 1910
Sloss-Sheffield, pr	117½	114½	— 3	6.1	7 n. c.	1¾ Q.	Jan., 1911
U. S. Pipe & Fdy. Co	32½	16½	—16	....	2	1 Q.	Dec., 1910
U. S. Pipe & Fdy. Co., pr	84⅛	51½	—32⅝	9.8	7 n. c.	1¼ Q.	Dec., 1910
U. S. Steel	91	72⅛	—18⅞	6.9	5	1¼ Q.	Dec., 1910
U. S. Steel, pr	125	116⅜	— 8⅝	6.0	7 cum.	1¾ Q.	Nov., 1910
U. S. Steel 5s	105⅛	104	— 1⅛	4.8	5	.....	.....
Va. Iron, Coal & Coke	73⅜	50	—23⅜	....		5. ‡	Oct., 1907
Westinghouse Electric	83	65½	—17½	10.6		5½ Q. **	Jan., 1911
Westinghouse Air Brake	148½	139	— 9½	6.5		5 Q. ‡	Jan., 1911

Par value of shares, $100, except those starred (*), $50.
**Includes 3½ per cent on back dividends.
†Stock.
‡Includes 1½ extra and 1 special.
††Net yield.

Pig Iron Output Record Broken in 1910

Last Half Failed to Show Expected Results of Curtailment Policy—Fewer Stacks Operating

The total output of coke and anthracite pig iron in the United States in 1910 was 26,838,380 tons. This was the largest annual production in the history of the American iron industry. The next largest production was that of 1907, when 25,299,732 tons were produced. But the year just closed surpassed the "boom year" total by 1,538,648 tons.

AVERAGE DAILY PRODUCTION.

	1910.	1909.
January	83,871	57,683
February	86,747	60,083
March	83,508	58,793
April	82,590	57,687
May	76,607	60,218
June	76,276	64,334
July	69,617	67,375
August	67,864	72,021
September	68,282	79,186
October	67,297	84,001
November	63,679	84,425
December	57,192	86,539

Reports received by telegraph, telephone and the mail through the kindly co-operation of blast furnace managers throughout the country show that the coke and anthracite pig iron production for December was 1,772,965 tons. This was the smallest monthly total since April, 1909. The daily average output in December was 57,192 tons, also the smallest since the same month. The merchant stacks produced 656,901 tons and the non-merchant or steel plant furnaces 1,103,466 tons. The output of spiegel was 5,433 tons and of ferro 7,165 tons. The number of stacks active on the last day of December was 196, compared with 218 on the last day of November.

MONTHLY PRODUCTION.

	1910.	1909.	1908.
January	2,599,995	1,788,164	1,043,374
February	2,428,937	1,682,470	1,086,809
March	2,588,736	1,822,644	1,229,856
April	2,477,700	1,730,608	1,155,122
May	2,374,802	1,866,757	1,168,002
June	2,288,279	1,930,029	1,106,300
July	2,158,124	2,088,620	1,229,604
August	2,103,791	2,232,642	1,366,019
September	2,048,461	2,375,589	1,416,252
October	2,086,205	2,604,037	1,573,824
November	1,910,385	2,532,740	1,582,314
December	1,772,965	2,682,702	1,723,664
Total	26,838,380	25,337,002	15,681,140

The year 1910 began with 311 stacks active and a high rate of production of 31,000,000 tons. It ended with 115 fewer stacks in operation and producing at a rate of 21,275,000 tons. The larger part of the record-breaking of 1910 was done in the first half, when 14,758,449 tons were produced; for in the second half output fell to 12,079,931 tons. In the first half of the year 4,807,644 tons were produced by merchant stacks, and in the second half 3,950,281 tons, a decrease of 857,363 tons. The non-merchant or steel plant stacks produced 9,779,985 tons in the first half, but the output declined to 8,017,370 tons in the second half, a decrease of 1,762,615 tons. In other words, steel plant furnace production declined twice as fast as merchant furnace output after curtailment had been finally decided upon by blast furnace owners. The merchant furnaces produced 555,911 tons more in 1910 than in 1909. The steel plant stacks turned out 949,824 tons more in 1910 than in 1909. The total output of all kinds of iron in the first half of 1910 was only 921,691 tons less than the total production for the entire year of 1908. The first half of the year just closed exceeded the last half in output by 2,678,518 tons, it exceeding the last half of 1909 by about 240,000 tons. The curtailment in the last half was not equal to the increase in the first half of 1909 by about 1,200,000 tons.

Directors of the Kansas City Structural Steel Co., Kansas City, at a recent meeting declared a dividend of 7 per cent on the preferred stock for the years 1908 and 1909, payable Jan. 31, 1911. The company was organized in the spring of 1907 and began operating its shops in October of that year. In the past year the company turned out over 16,000 tons of fabricated material.

Railroad Building

Statistics collected by the *Railway Age Gazette* show that railroads in the United States during the ear 910 built 4,122 miles of new main track, and ordered 3,787 locomotives for use on the various lines. During the year 180,945 freight cars, 4,412 passenger cars, and 4,755 locomotives were completed. The figures for 1909 are: Freight cars, 93,570; passenger cars, 2,849, and locomotives, 2,887. This shows a substantial increase for 1910 in all departments. On the other hand the amount of equipment ordered by railways in 1910 has been smaller than in 1909 and relatively small as compared with the amount ordered on the average for the last decade. Twenty-seven railroads in this country made increases in their regular dividends to stockholders.

DECEMBER FURNACE REPORT.

STATES.	NO. OF STACKS.	NO. IN BLAST ON LAST DAY OF MONTH. DEC.	NO. IN BLAST ON LAST DAY OF MONTH. NOV.	AV. DAILY CAPACITY IN BLAST LAST DAY OF MONTH. MERCHANT.	AV. DAILY CAPACITY IN BLAST LAST DAY OF MONTH. NON-MERCHANT.	TOTALS. DEC.	TOTALS. NOV.
Pennsylvania	157	78	84	181,790	544,282	726,072	769,048
Ohio	71	37	40	137,686	236,599	374,285	402,335
Alabama	45	18	21	111,090	32,749	143,839	166,447
Virginia	24	9	10	29,640	———	29,640	28,072
New York	26	15	15	70,569	71,415	141,984	142,735
New Jersey	7	2	2	15,450	———	15,450	18,284
Illinois	26	10	15	36,323	93,678	130,001	187,046
Colorado	6	3	4				
Indiana	8	3	5	18,760	116,289	135,049	121,394
Maryland	4	2	3				
Wisconsin	6	3	3				
Kentucky	7	2	2				
West Virginia	4	1	1	33,902	8,454	42,356	38,262
Tennessee	19	9	8				
Washington	1	0	0				
Georgia	2	1	1				
Texas	3	0	0				
Minnesota	1	1	1	21,691	———	21,691	21,877
Michigan	3	2	3				
Missouri	1	0	0				
Spiegel—All states.						5,433	5,435
Ferro—All states.						7,165	9,450
Total	421	196	218	656,901	1,103,466	1,772,965	1,910,385

Corey Resigns from Corporation Presidency

Judge Gary Issues Statement Saying Successor will not be Elected Soon, if at All—Words of Praise for Services

William E. Corey, president of the United States Steel Corporation, has resigned. In a formal statement, issued late Tuesday afternoon, Judge E. H. Gary, chairman of the United States Steel Corporation, announced the receipt of President Corey's resignation.

A significant paragraph in the Gary statement points out that a successor to Mr. Corey will not be chosen by the finance committee immediately. In fact, it is intimated that one or more additional vice presidents may be chosen upon whom will devolve some of the duties heretofore pertaining to the office of president. In his statement Judge Gary says:

After more than seven years of faithful service as president of the United States Steel Corporation, William E. Corey has tendered his resignation to take effect at the pleasure of the board of directors. The resignation will be presented to the board for consideration and action in due time, and the finance committee will then present its recommendations concerning the subject matter.

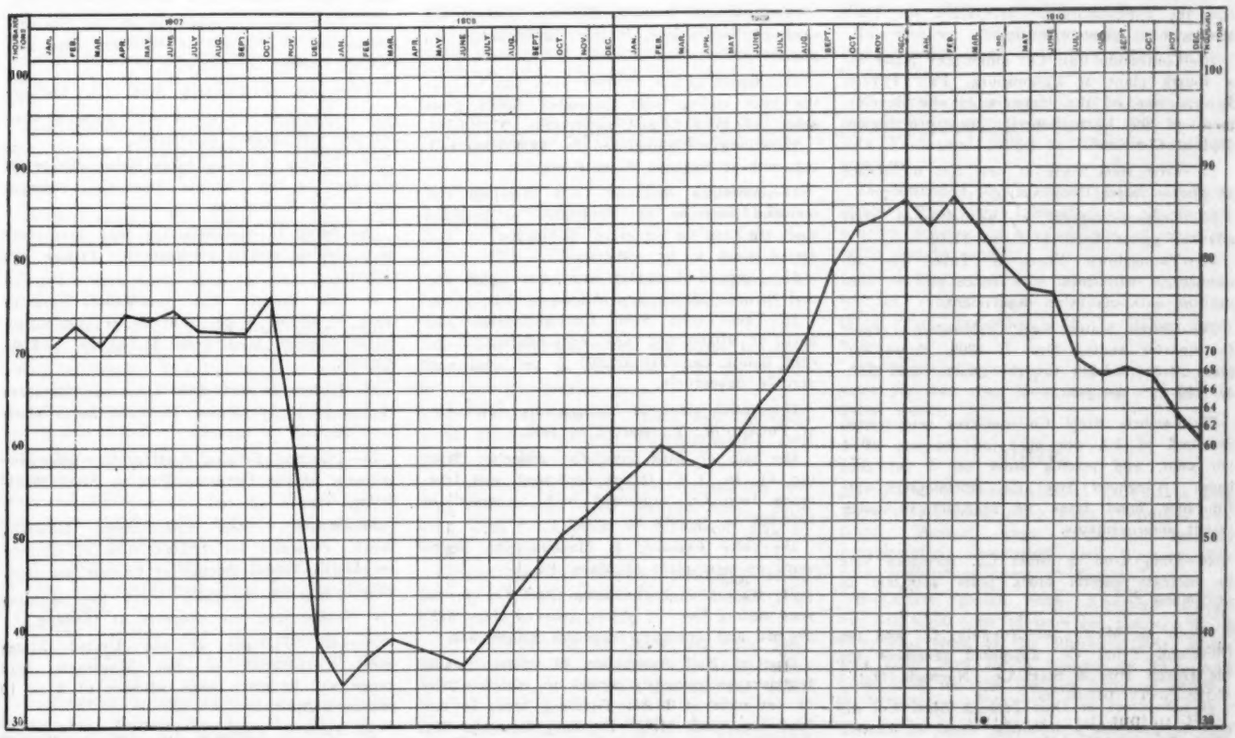
It is the joint opinion of the members of the finance committee that there should not be elected a successor as president in the immediate future, if at all. The experience and talents of Mr. Corey have best fitted him to take charge of the commercial and manufacturing departments and his attention has been largely confined to that service. However, as the manufacturing companies are all thoroughly equipped with the very best talent, including such as the above mentioned branches need, the strength of the organization will not be diminished. The finance committee may recommend the election of a vice president or two vice presidents, who will be expected to take special charge of different departments. It is intended to strengthen the whole organization in every respect practicable and useful.

The relations between Mr. Corey and the members of the board and of the finance committee respectively as well as all the officers of the United States Steel Corporation and subsidiary companies have been most pleasant and agreeable. Mr. Corey severs his connection with a feeling of loyalty to and friendship for the Corporation and all its interests and takes with him the best wishes of all who are connected with the companies above referred to.

William Ellis Corey was chosen president of the United States Steel Corporation on Aug. 4, 1903. He had filled the office as acting president, following the resignation of President Charles M. Schwab. Up to that time, Mr. Corey had been president of the Carnegie Steel Co., a subsidiary of the Steel Corporation. Mr. Corey was born in 1866 in the state of Pennsylvania. When he was 16 years old, he entered the chemical laboratory of the Edgar Thomson plant. His abilities and keen pursuit of practical knowledge of steel making gained him early recognition and at the age of 21 he was appointed superintendent of the armor plate department of the Carnegie Steel Co. He then became president of the Carnegie company, the National Steel Co. and the American Steel Hoop Co. His career subsequent to his election as president of the Steel Corporation is too well known to need further reference in this brief sketch.

At the time of Mr. Corey's election to the presidency, the office of chairman of the board of directors was created and Judge Gary was chosen to fill it.

D. W. McGrath, who was awarded the general contract for the new Ohio state university library, has let the steel, of which there is about 300 tons, to the Columbus Structural Steel Co., Columbus. The mill contract has not yet been awarded.



PIG IRON PRODUCTION FOR FOUR YEARS.

Chronology of Iron and Steel Business in 1910

Important Happenings Concerning Both Men and Works— Course of Various Markets Briefly and Comprehensively Sketched

JANUARY.

1—Iron and steel pipe manufacturers put new classification into effect.

3—American Bridge Co. takes contract for 8,000 tons of steel for new mill of the American Sheet & Tin Plate Co. at Gary, Ind.

4—Pennsylvania Steel Co. awarded contract for 25,000 tons of steel for municipal building in New York.

7—Lake ore freight rates advanced 5 cents per ton over last year and handling charge at lower lake ports reduced 5 cents per ton.

8—Hoop prices stiffen as result of increased demand.

10—H. C. Frick Coke Co. restores wage scale to the level prior to reduction on Jan. 1, 1908.

11—More general inquiry for pig iron develops in different centers and some large purchases made.

12—Bi-monthly examination shows 1.40c card on bar iron and $5.50 boiling rate, as in November and December of 1909.

13—Connellsville coke production for the year 1909 announced as 17,785,832 tons.

14—Jones & Laughlin Steel Co. announces tin plate plant at Aliquippa, Pa., will eventually contain 36 mills, the largest in the world.

17—Pittsburg Steamship Co. charters vessels to move 15,000,000 tons of ore and expects to move about 12,000,000 in its own boats during the season of 1910.

18—United States Steel Corporation authorizes the expenditure of $2,450,000 for Portland cement plant extension.

20—Continental Can Co. announces plans for a fourth plant at Canonsburg, Pa. Fayette Brown, one of the pioneers in the development of the Lake Superior iron ore region, died at Cleveland.

21—First steel made at new No. 6 furnace of Sharon Steel Hoop Co.

22—German makers of semi-finished steel advance prices from $1.25 to $1.50.

23—Youngstown Sheet & Tube Co. announces it will build wire fence mill in connection with its wire department.

24—United States Steel Corporation's report for quarter ending Dec. 1, 1909, shows surplus of $16,263,339 for the quarter and $27,339,430 for the year.

25—Cambria Steel Co. declares semi-annual dividend of 2½ per cent, an increase of 1 per cent, and placing stock on 5 per cent basis. Allegheny Steel Co. stockholders vote for new bond issue of $150,000 to cover recent improvements.

26—Ohio Iron & Steel Co. directors vote to increase capital stock from $500,000 to $5,000,000.

27—E. G. Martin, of Norwalk, O., and the Cleveland Trust Co. appointed receivers for the Huron Iron & Steel Co., Norwalk, O.

28—Directors of Ohio Iron & Steel Co. decide to postpone indefinitely work on Lowellville, O., improvements, owing to failure to obtain prompt shipment on machinery.

29—Union Furnace Co., of Ironton, O., taken over by Rogers, Brown & Co.

31—Assistant Secretary of the Treasury Curtis announces modification of scrap clause of 1909 tariff act.

FEBRUARY.

1—Syndicate of Buffalo capitalists buys entire stock of the Buffalo Tool & Machinery Co. from receivers.

2—Union of lake employes demands higher wages at annual meeting in Washington.

3—Monthly statistics show production of pig iron in January 2,597,181 tons, a decrease of 85,521 tons as compared with December.

4—Westinghouse Air Brake Co. shows new high record in volume of business booked in January, orders aggregating $2,000,000.

5—Standard Steel Car Co. pays $235,000 for the Verona, Pa., plant of the General Castings Co.

7—Annual report of American Can Co. for fiscal year ended Jan. 31, shows net profits of $2,546,152, an increase of $49,888. Republic Iron & Steel Co. announces that the Corns plant at Massillon, O., will be abandoned March 1.

8—United States Steel Corporation buys 40,000 tons of Bessemer pig iron, establishing a new price of $18, valley, a reduction of $1 a ton as compared with the previous week.

9—Copper Producers' Association's January report shows production of 159,850,059 pounds, as compared with 129,066,071 pounds in December.

10—American Rolling Mill Co. awards big contract for equipment for Middletown, O., plant.

11—Report of the Pressed Steel Car Co. for the year ending with December shows gross sales, $10,346,816, and net profits, $1,954,582.

12—Plans are announced for $4,000,000 rolling mill at Sydney, Nova Scotia.

14—American Radiator Co.'s directors recommend increase of $2,000,000 in common stock in lieu of unissued $2,000,000 of preferred stock to be withdrawn.

15—Jones & Laughlin Steel Co. lights second furnace of the new Aliquippa, Pa., group.

16—Lackawanna Steel Co. authorizes issuance of $10,000,000 new consolidation 5 per cent bonds and $10,000,000 5 per cent convertible debentures.

17—Initial plant of Lackawanna Steel Co., at Buffalo, N. Y., started in full.

18—Sale of Bird Iron Co. property, Ironton, O., to D. C. Davies confirmed, and Lawrence Iron Co. organized with a capital of $250,000 to operate the plant.

19—Velte Foundry & Machine Co. begins work on new plant at Mars, Pa.

21—Report of Lackawanna Steel Co. for the year ending Dec. 31 shows gross earnings $25,296,661 and operating expenses $20,586,838.

22—Cut Nail Association of eastern manufacturers unanimously agrees to maintain price of cut nails at $1.85, Pittsburg base, in carload lots, and $1.90, Pittsburg base, in less than carloads.

24—Returns of American Iron and Steel Association give production of all kinds of pig iron in Canada in 1909 as 677,090 tons, compared with 563,672 tons in 1908.

28—Statistics of American Iron and Steel Association give production of rails in the United States in 1909 as 3,062,582 tons, as compared with 1,921,611 tons in 1908.

MARCH.

1—John D. Rockefeller Jr. resigns as director of United States Steel Corporation. The Maryland Steel Co. makes its first open-hearth steel at the Sparrows Point plant.

2—Returns from all iron ore mines in Lake Superior district for 1909 season show 42,586,869 tons forwarded by lake and rail—41,683,599 tons by lake, and 903,270 tons by rail.

3—President A. C. Dinkey, of Carnegie Steel Co., announces plans for new splice bar mill at Edgar Thomson plant, at Braddock, Pa.

4—American Institute of Mining Engineers holds annual convention in Pittsburg.

7—Southern Railroad Co. takes over the Lenoir, Tenn., plant of the Bass Foundry & Machine Co., Fort Wayne, Ind., at $400,000.

8—McMyler Mfg. Co., Cleveland, buys plant of the Interstate Engineering Co., at Bedford, O.

9—New Castle Iron & Steel Co., New Castle, Pa., organized with a capital of $100,000.

11—Five Buffalo furnace interests temporarily restrain eight railroads from putting into effect higher freight rates on Connellsville coke.

14—First annual convention of the National Association of Jobbers of Wrought Pipe and Fittings opened in Pittsburg.

15—Report of Cambria Steel Co. for the year ending Dec. 31 shows total income $2,924,277 and net income $2,538,086.

17—Charles S. Price takes active charge as president of the Cambria Steel Co., succeeding Powell Stackhouse.

18—Owing to dissatisfaction with blast furnace results, several contracts for foreign ore canceled.

21—Otis Elevator Co. stockholders vote to issue $3,500,000 5 per cent bonds and to increase common stock from $6,500,000 to $10,000,000.

22—Hiram Swanks Sons Co., manufacturers of fire brick, Johnstown, Pa., announces plans for doubling its capacity.

23—Diamond Forging & Mfg. Co. takes over property of the Pittsburg Tubular Steel Whiffletree Co.

24—Western Steel Corporation, Irondale, Wash., contracts for 100,000 tons of Chinese ore and an equal amount of Chinese pig iron.

25—Jones & Laughlin Steel Co. acquires the Nassau iron ore property at Hibbing.

26—All employes of the United States Steel Corporation or the Minnesota iron range will be given wage advance of 8 to 10 per cent April 1.

29—General Chemical Co. awards contracts for additions to its Pittsfield, Mass., plant to cost $2,000,000.

APRIL.

1—Freight rates restored from seaboard to consuming points on ferro-manganese, electrolytic, ferro-silicon and spiegeleisen to the basis prevailing up to Jan. 1 advance.

2—Coatesville interest buys 25,000 tons of basic. Irregularity in pig iron prices noted. Official announcement of consolidation of the Alan Wood Iron & Steel Co. and Richard Heckscher & Sons Co.

4—Owing to coal miners' strike, some users of other grades of coke in outside districts have been obliged to buy Connellsville coke. The Panama canal commission in market for 58,000 tons of steel.

5—Maryland Steel Co. starts second new open-hearth furnace at Sparrows Point, Md.

6—One important company withdraws from associated buyers of scrap in the Philadelphia district.

6—Another block of 25,000 tons of foreign ore cancelled and resold. Lorain, O., tube plant of the National Tube Co. closed.

7—Bethlehem Steel Co. officials celebrate at South Bethlehem, Pa., fiftieth anniversary of founding of Bethlehem steel works.

8—Official reports show American Sheet & Tin Plate Co. in March broke all previous records in sheet production by 2,000 tons, in spite of Aetna Standard Works, idleness. The Anniston Iron Corporation, Lynchburg, W. Va. buys two Woodstock furnaces at Anniston, Ala.

9—Old Shelby Tube Co. plant at Greenville, Pa., sold to J. R. Calking and C. P. Rogers Jr., of Corry, Pa. Rock Island Railroad Co. enters the market for 2,000 cars and 95 locomotives.

11—American Sheet & Tin Plate Co. awards contract for foundations and buildings for first 22-mill unit of big plant at Gary.

12—Jones & Laughlin Steel Co. lights third new blast furnace at Aliquippa.

13—Republic Iron & Steel Co. starts butt weld department of new tube mill at Youngstown, O. Contracts awarded for two new Iroquois furnaces at Chicago and a second stack for Corrigan-McKinney & Co. at Cleveland.

14—Westinghouse Electric & Mfg. Co. will build a large foundry plant at Trafford City, Pa. Further shading of prices on plates in central west.

15—McKeesport Tin Plate Co. starts five of the 10 new tin mills at the McKeesport, Pa., plant. Pittsburg, Shawmut & Northern railroad orders 6,500 tons of steel from American Bridge Co.

16—About 45,000 tons of steel scrap placed on the market in New York territory and prices are weak. The Pennsylvania Steel Co. authorizes issue of $4,087,500 additional preferred stock to cover last of plant extensions and improvements.

17—Movement started to curtail pig iron production. A contract awarded by Western Maryland Railroad Co. for the 83-mile extension from Cumberland, Md., to Connellsville, Pa., to cost $12,500,000.

19—Contract awarded by Boston & Maine railroad to Pennsylvania Steel Co. for 11,000 tons of rails.

20—The blowing out of additional blast furnaces causes a sharp curtailment in production of coke.

21—Belmont furnace of the Wheeling Steel & Iron Co.; furnace No. 2 of La Belle Iron Works, Steubenville; Clinton furnace, of the Clinton Iron & Steel Co., Pittsburg, and five stacks of the Carnegie Steel Co. blown out. Tennessee Coal, Iron & Railroad Co. awards contract for 280 Koppers by-product coke ovens at Birmingham, Ala.

22—Settlement of miners' troubles tends to decrease demand for Connellsville coke. United States Radiator Co. formed with capital of $8,000,000 by merging five plants in central west.

23—Dock superintendents at Cleveland advance wages of ore and coal handlers 5 per cent, effective May 1.

25—Lively cutting of prices on sheets, except blue annealed. Contracts awarded for 6,000 freight cars.

26—Jones & Laughlin Steel Co. increased number of directors by two, and awarded contract for replacing No. 1 Eliza stack with modern furnace.

27—United States Steel Corporation places common stock on initial 5 per cent per annum basis. Orders given by consumers of scrap to reduce shipments and prices are lower.

28—American Iron & Steel Association reports production of all kinds of Bessemer ingots and direct steel castings in the United States in 1909 was 9,330,783 tons, compared with 6,116,755 tons in 1908.

29—The new Earlston furnace at Everett, Pa., owned by Joseph E. Thropp, blown in.

MAY.

2—New wage scales of United States Steel Corporation, Jones & Laughlin Steel Co., Republic Iron & Steel Co., Youngstown Sheet & Tube Co. and others become effective, providing advance of from 1 to 6 per cent.

3—Official reports show 23 furnaces blown out during April and consumers show more interest on account of decreased production. John H. Converse, president of Baldwin Locomotive Works, died at Philadelphia.

4—Inquiries for 150,000 tons of structural material pending, but contracts are very slowly closed. Mannesman Tube Works, of Germany, acquires patents and machinery formerly used at the Monessen, Pa., plant of the Pittsburg Steel Co., and will build a plant in this country.

5—Market on all finished lines dull and further evidence of price concessions noted.

6—An eastern steel company closes with Jamison Coal & Coke Co., Pittsburg, for 7,000 tons of furnace coke a month for a period of 5 years. H. C. Frick Coke Co. closes down 4,000 ovens.

7—New record established for shipments of Lake Superior iron ore, approximately 1,500,000 tons in April.

9—Fund of $8,000,000 set aside by Steel Corporation to be combined with the $4,000,000 Carnegie pension fund.

10—Whitaker-Glessner Co. will probably break ground this year for open-hearth steel plant near Martins Ferry, O.

11—New business of Steel Corporation running considerably better than in April. Pittsburg Steel Co.'s plant at Monessen, Pa., resumes operations.

12—An eastern furnace purchased 30,000 tons of furnace coke for last half at $1.85 ovens.

13—Some cutting on plates, but 1.50c Pittsburg is ordinarily the lowest price. Canton Sheet Steel Co. breaks ground for 8-mill plant.

14—Associated scrap buyers in Philadelphia strengthened by the return of one of their number. Cambria Steel Co. closes for 5,000 tons of ferro-manganese for last half at about $41 seaboard.

15—James Wallace Van Cleave, president of Buck's Stove & Range Co., St. Louis, and former president of the National Association of Manufacturers, died at St. Louis.

16—Jones & Laughlin Steel Co. starts six of 12 new tin mills at Aliquippa, Pa., this the first finished material turned out of this plant.

17—Harriman lines order 12,400 freight cars. The movement of ore is slow on the lakes, furnaces not being anxious for delivery.

18—Better tone in pig iron market in the east and inquiries covering approximately 15,000 tons are pending. First sale of Bessemer reported below $17.

19—N. & G. Taylor Co., Philadelphia, buys active operating plants of the Maryland Tin Plate Co. and the Maryland Sheet & Steel Co.

20—Important orders for line pipe are placed, including 269 miles of 10, 12, 16 and 18-inch for Arkansas Natural Gas Co. Steel Corporation operates 88 stacks out of a total of 119. Oliver Chilled Plow Works, South Bend, Ind., buys 75 acres at Hamilton, Ont.

21—Estimated tonnage of structural steel contracted so far this year 600,000 tons.

22—Price concessions of $1 and $2 a ton on black sheets and from $2 to $3 a ton on galvanized sheets offered by small independents. Sales of 15,000 tons of basic pig iron in Pittsburg territory establish a market price of $15 valley.

23—Montreal Steel Works begins construction of $2,000,000 plant at Longue Pointe, Montreal.

24—Birmingham, Ala., furnaces show a strong disposition to adhere to $12 for No. 2 Birmingham, although lower prices are quoted by outsiders.

25—Reuben Miller resigns as third vice president of Crucible Steel Co. of America, and C. C. Ramsey elected successor.

26—Western Steel Corporation, Irondale, Wash., makes first steel for rolling on the Pacific coast.

27—First regular meeting of American Iron and Steel Institute, organized in 1908, held in New York, and Judge E. H. Gary re-elected president.

28—Railroads decide upon further retrenchments. Two more cancellations of foreign ore on account of the advance of trans-Atlantic freight rates.

30—Cambria Steel Co. closes for maximum tonnage 720,000 tons of furnace coke for three years, beginning July 1. Coke prices weak.

31—Steel Corporation reports consuming more pig iron than it is making and has reduced stocks.

JUNE.

1—Jones & Laughlin Steel Co. makes first shipment of black plate from Aliquippa, Pa., plant. Annual wage conference between Amalgamated Association and Western Bar Iron Association opens at Detroit.

2—Orders placed with American Bridge Co. for 6,000 tons of steel for the new Ford City, Pa., plant of the Pittsburg Plate Glass Co.; 2,500 tons for a foundry at Erie, and 1,300 tons for the DuPont building addition at Wilmington, Del.

4—First step taken by Connellsville coke operators to merge operating companies.

6—Sharon, Pa., casting company closes for

18,000 tons of basic and Bessemer pig iron, and Westinghouse Air Brake Co. for 15,000 tons of No. 2 foundry and gray forge.

7—Order placed with American Bridge Co. by Steel Corporation for 10 steel barges. Annual convention of the American Foundrymen's Association at Detroit.

8—Warwick Iron & Steel Co. begins construction blast furnace at Pottstown, Pa.

9—Reports show in May, ten merchant stacks and four non-merchant stacks blown out and one merchant furnace was banked. Major Joseph T. Spear, of Pittsburg, elected president of the American Foundrymen's Association at Detroit.

10—Buyers of wrought iron scrap form a central agency in the Philadelphia district.

11—Prices of heavy melting steel reduced 25 cents a ton and entire market appears to be weak.

13—Iron workers of Los Angeles, Cal., strike.

14—Bids entered at Washington, D. C., for mitre gates for Panama canal locks requiring 60,000 tons of steel. President J. H. Plummer, of the Dominion Iron & Steel Co., announces wire products plants will be built in Canada.

15—Quotations of $14.50 on No. 2 foundry and $14.50 on malleable established by sales in central territory.

17—C. C. Ramsey elected president of Crucible Steel Co. of America, succeeding Herbert DuPuy, who remains chairman of board.

18—Bar iron market shows further weakness, 1.35c mill, being quoted in eastern territory.

20—National Tube Co. blows out active furnace and shuts down steel works at Benwood, W. Va.

21—New York Central lines sell $22,500,000 equipment trust to cover cost of 214 locomotives, 105 passenger cars and 20,850 freight cars.

22—Government awards contract to the McClintic-Marshall Construction Co., Pittsburg, for Panama canal locks.

23—Follansbee Bros. Co. awards contract for two new sheet mills at Follansbee. Bessemer pig iron sold at new low price of $15.75.

24—The old sheet and tin plate scale of wages reaffirmed by independents.

25—Baltimore & Ohio railroad orders 1,000 all-steel coke cars from Cambria Steel Co., 1,000 all-steel coke cars from Pressed Steel Car Co. and 1,000 steel underframe box cars from Standard Steel Car Co.

27—Low quotations made on furnace coke, a Cleveland interest taking 6,500 tons for July delivery at $1.55, ovens.

28—Pig iron market shows weakness and many inquiries withdrawn.

29—General tendency toward lower level on pig iron and nearly all finished lines. Extensions of contracts for finished lines.

30—Several steel plants closed for inventory and repairs. First half of the year has failed to fulfill the rosy expectations.

JULY.

1—New record in pig iron production during the first half of 1910, 14,761,264 tons, an increase of 1,500,000 over the first half of 1907.

2—McClintic - Marshall Construction Co. awarded a contract for 12,000 tons of steel for bridges along the Western Maryland railroad extension. Lukens Iron & Steel Co. celebrates centennial of Coatesville, Pa., plant.

4—Practically all mills closed for holiday.

5—Carnegie Steel Co. announces Isabella No. 2 stack will be torn down and replaced.

6—Further cutting of prices on sheets noted. Wheeling Mold & Foundry Co. awarded contract for steel castings and other material for Panama canal lock gate work.

7—Jones & Laughlin Steel Co. gets contract for 40,000 tons of plates, and 18,000 tons of shapes for Panama canal lock gate work. New low price of $14.10, valley, for No. 2 foundry.

8—Texas Co. awards contracts to LaBelle Iron Works and National Tube Co. for 200 miles of 6 and 8-inch steel pipe. Carnegie Steel Co. makes open-hearth steel rails at Ohio works for first time in plant's history.

9—Low Moor Iron Co., Low Moor, W. Va., put a new brand of soft Virginia pig iron on market.

11—Lower prices named on pig iron in several sections, Bessemer selling at $15.50, valley, and basic at $14.50, valley. Myron C. Wick died at Youngstown, O.

12—Westinghouse Electric & Mfg. Co. closes for 12,000 tons of foundry coke for one year at $2.25, ovens. Pittsburg company reports sales during the past six weeks of 200,000 tons of foundry coke at $2.50, ovens.

13—No. 2 foundry sold at $14, valley.

14—Wire and wire nail prices reduced $2 a ton, as compared with those quoted July 1, and $3 a ton since May 1, to $1.50 on plain wire and $1.70 on wire nails.

15—Commission houses in the east offer Mesabi non-Bessemer ore at concession of 50 cents ton.

16—Coke shipments increased on account of threatening strike of Pennsylvania trainmen.

18—Buck's Stove & Range Co., St. Louis, agrees to abandon open shop policy.

19—Pig iron market shows less life, but prices have changed very little. Irregularity in prices of plates and shapes.

20—Republic Iron & Steel Co. signs new wage scale of Amalgamated Association, providing for an increase of 50 cents a ton for puddlers.

21—Walter C. Harris appointed receiver for Dunbar Furnace Co., Dunbar, Pa.

22—Bethlehem Steel Co. closes with Davis Coal & Coke Co. for supply of coal for 20 years.

24—Bids invited on water pipe line systems at Los Angeles, Cal., and Portland, Me., involving 28,000 tons of plates.

25—Chickamauga Steel & Iron Co. incorporated at Trenton, N. J.

26—Basic iron prices show further decline, a Pittsburg middleman taking 10,000 tons at $14, valley.

27—Standard Tin Plate Co., Canonsburg, Pa., grants increase in wages to employes of hot mills.

28—Jones & Laughlin Steel Co. opens books for orders of wire products against new mills at Aliquippa. W. C. Moreland, new ore boat of Jones & Laughlin Steel Co., launched at Lorain, O.

29—American Sheet & Tin Plate Co. awards general contract to William Tod Co., Youngstown, O., for 16 sheet and four jobbing mills at Gary, Ind. Edwin F. Atkins, of Boston, elected president of Westinghouse Electric & Mfg. Co. to succeed George Westinghouse.

30—Bayonne Casting Co., Bayonne, N. J., takes largest contract ever awarded for monel metal castings for two battleships for Argentine Republic.

AUGUST.

1—Monthly reports show gradual reductions in production of pig iron.

2—Westinghouse Electric & Mfg. Co. buys 70 acres at Trafford City, Pa., to centralize its foundry plants there. Monongahela valley sheet and tin plate company closed contract, whereby a large steel company will take its entire output of scrap, amounting to 1,100 tons a month, for term of years.

3—Some mills reduce price of steel bars to 1.40c, Pittsburg. Price of blue annealed sheets reduced $1 ton. Report of price concessions on steel rails officially denied by Steel Corporation and independents.

5—Work started dismantling Toledo plant of Republic Iron & Steel Co.

6—The Standard Sanitary Mfg. Co. closes for 20,000 tons of foundry coke for one year at $2.30, ovens. A. M. Byers Co., Pittsburg, begins work on 46 additional puddling furnaces at Girard, O., plant.

8—American Sheet & Tin Plate Co. awards contract to United Engineering & Foundry Co. for two plate mills to be built at Gary.

9—Contracts for 150 miles of steel pipe placed in Pittsburg territory.

10—Steel Corporation reports unfilled orders on July 30, of 3,970,931 tons, compared with 4,257,794 tons on June 30.

11—Steel Corporation operating 70 per cent of blast furnace capacity.

12—Sheets are weakest product in entire market and price cutting extended to blue annealed sheets.

13—American Bridge Co. awarded contract for 10,000 tons of steel for New York Central terminal improvements in New York City.

15—Chicago broker offers black sheets at $1 a ton below prices quoted this year.

16—Furnace C, the last of a group of three built by Youngstown Sheet & Tube Co., blown in.

17—Inquiries for 50,000 tons of basic pig iron appear in central western territory and the market appears firm at $14, valley.

18—Makers of special sheets used by automobile concerns feeling severely depression in automobile trade and shipments fall off.

19—New plant of Forged Steel Wheel Co., at Butler, Pa., completed.

20—Congestion at upper lake ore docks causes decided slump in coal shipments to northwest.

22—Otis M. Childs, chairman of board of United Engineering & Foundry Co., died in Pittsburg. Inquiries for 25,000 tons of steel bars for last half delivery appear in east.

23—Executive board of Amalgamated Association votes to discontinue strike against the American Sheet & Tin Plate Co., declared June 30, 1909.

24—Steel Corporation places orders with American Locomotive Co. for 16 locomotives.

25—Tone of pig iron market improved by the buying of 70,000 tons by plow and cast iron pipe interests.

26—No. 1 Eliza stack, Jones & Laughlin Steel Co., Hazlewood, Pa., relighted after being torn down and rebuilt in 95 days.

27—Bulk freighter William B. Dickson launched from the Ecorse yards of Great Lakes Engineering Works.

29—American Sheet & Tin Plate Co. operating 84 per cent of entire serviceable capacity of hot mills, compared with 58 per cent last year.

30—Coke production gradually decreases and now about equal to consumption.

SEPTEMBER.

1—Steel Corporation denies completing plans for Pacific coast steel works.

2—Reports show August shipments of the leading wire interest exceeded any month in its history.

3—Report of Republic Iron & Steel Co. for year ended June 30, shows heaviest bookings in its history.

5—New blast furnace of Wickwire Steel Co., at Buffalo, lighted.

6—The deadlock between buyers and sellers of Bessemer pig iron for 1911 broken and the first sale reported at $15, valley.

7—Inland Steel Co. closes for 10,000 tons of basic pig iron to be shipped by water from Toledo and Detroit.

9—Rogers, Brown Iron Co. announces plans for the construction of a fleet of barges to operate on the Erie canal.

10—Monthly statement of Steel Corporation shows large decline in unfilled tonnage.

12—American Sheet & Tin Plate Co. makes first move to operate plants affected by Amalgamated Association strike at Laughlin tin plant, at Martins Ferry and Bridgeport, O.

13—President James A. Campbell, of Youngstown Sheet & Tube Co., announces plans for open-hearth steel plant at Youngstown, O.

14—Railroad buying disappointing.

15—Ohio melter enters the market for 25,000 tons of basic and a radiator company inquires for 42,000 tons of iron for 1911 delivery.

16—Western Steel Corporation buys ore properties in Lynn and Storey counties, Nev.

17—Republic Iron & Steel Co. provides $20,000 for converting puddling mill at East Chicago into a busheling mill.

19—False reports regarding price concessions depress the market and buyers hesitate.

20—Two modern merchant mills will be erected at Brown-Bonnell plant of Republic Iron & Steel Co.

21—Dr. Richard Moldenke announces the date for the 1911 convention of the American Foundrymen's Association, in Pittsburg, set for May 23 to 26.

22—American Iron & Steel Association announces production of wire rods for 1909, 2,335,683 gross tons, gain of 518,736 tons over 1908.

23—Final preparations made for first formal meeting of American Iron and Steel Institute in New York, Oct. 14.

24—Sheet manufacturers meet in Pittsburg to discuss trade condition.

26—Two furnace interests in Pittsburg territory close for 40,000 tons of furnace coke for October at $1.60, ovens.

27—Increasing firmness on finished lines of steel noted despite rumors.

28—Slump in ore movement and indications are lake season will end early.

30—Small mills making extremely low quotations on sheets filled up and fewer reports heard of lower prices.

OCTOBER.

1—National Tube Co. and independents issue new price card for steel pipe which represents reclassification. Changes show reductions of $2 and $4 and advances of $2 to $4 per ton. Reductions range from $8 to $20 per ton on extra strong.

3—Important changes in differentials between gages of galvanized sheets, intended to correct inconsistent differentials long prevailing.

4—Inland Steel Co., Chicago, purchases 10,000 tons basic at $14.55 delivered at Indiana Harbor, Ind.

5—Nine fewer stacks in blast than a month ago and pig iron producers arrange for further curtailment.

6—Ft. Pitt Bridge Co., Pittsburg, awarded contract for 12,000 tons grade crossing elimination work along Long Island railroad.

7—Wire business is most encouraging feature of the finished lines.

8—Manufacturers of iron pipe follow lead taken by steel pipe makers in revising price card. Dissolution of syndicate of six leading consumers of steel scrap in the east.

10—Shipments of steel made more rapidly than new orders entered and monthly report of Steel Corporation shows decline 379,000 tons unfilled orders.

11—Executive officers of various foundrymen's associations meet in Pittsburg to arrange for annual convention. Foundry & Machine Exhibition Co. forms permanent organization.

12—New low price of basic for year established by sale of 2,500 tons to Pittsburg consumer at $13, valley.

13—American Iron and Steel Association reports production of black plates, or sheets, for tinning together with tin and terne plate in 1909 as 606,844 gross tons and 513,771 tons.

14—First formal meeting of American Iron and Steel Institute at the Waldorf Astoria, New York City, attended by representatives of two hemispheres.

15—Freighter, William P. Palmer, launched from Ecorse yards of Great Lakes Engineering Works.

17—Carnegie Steel Co. stops paying commissions to jobbers and sends out 20 salesmen to represent Pittsburg warehouse. Last of the Sons of Vulcan strikes called off when 200 members return to Lockhart Iron & Steel Co., McKees Rocks, Pa.

18—Cast iron pipe interests buy 20,000 tons pig iron. Government orders 5,000 tons of sheet steel piling for cofferdam constructions in raising Maine. Michael Baackes, father of the wire nail industry in America, died at Crefeld, near Dusseldorf, Germany.

19—American Hardware Manufacturers' Association and National Hardware Association open joint convention at Atlantic City. Railroads are still buying sparingly.

20—Connellsville coke operators renew efforts to organize a central selling agency.

21—Eastern industrial companies show more willingness to take up pig iron propositions.

22—President Taft receives members and guests of American Iron and Steel Institute at Washington. First lot of all-steel suburban coaches built for the Pennsylvania Railroad Co. received.

24—Eastern furnace interests at hearing in Buffalo blame railroad agents for advance in coke freight rates. Prices of prompt furnace coke are somewhat lower.

25—National Machine Tool Builders' Association's ninth annual convention in New York City takes a determined stand against the cancellation of orders.

26—More general buying of pig iron, recent sales including 33,000 tons of basic to central western consumer, 20,000 tons of malleable to leading radiator interest, and 30,000 tons of basic in Pittsburg territory. A. O. Blackburn disposes of interest in the Sharon Steel Hoop Co., and resigns as vice president.

27—Slump in ore shipments, some wild carriers returning from the head of the lakes without cargoes. President E. H. Gary, of American Iron and Steel Institute, appoints committee to investigate Sunday labor in mills.

28—Companies open books for 1911 rail orders and announce new method of quoting rails on 100-pound unit basis.

29—Delaware, Lackawanna & Western orders 1,000 freight cars.

31—Basic pig iron manufacturers endeavor to check competition at a meeing in east. Increased activity in the ferro-manganese market.

NOVEMBER.

1—Deadlock between buyers and sellers of crude steel over prices for 1911 delivery.

2—Owing to falling off in coke shipments, Pittsburg railroads remove racks from several thousand freight cars. Three furnaces of Cambria Steel Co., one of Jones & Laughlin Steel Co., and several in eastern Pennsylvania blow out, Carnegie Steel Co. operating about 63 per cent of furnace capacity.

3—Steamer W. C. Moreland, Jones & Laughlin Steel Co., which went to the rocks at Eagle river, Lake Superior, on Oct. 18, is abandoned to underwriters.

4—Large consuming interests place contracts for tin plate requirements over first half 1911. Inland Steel Co., Chicago, secures an option on 120 acres of iron ore land on the Cuyuna range.

5—Small mills shade prices on plain wire and wire nails $1 a ton. Standard Oil Co. buys holdings of the J. C. Trees Oil Co. in Louisiana field and latter's inquiry for pipe withdrawn.

7—Directors of Republic Iron & Steel Co. decide to move general offices from Pittsburg to Youngstown.

8—Cambria Steel Co. places new 8-inch Morgan continuous mill in operation. Elections prove disturbing factor to iron and steel trade.

9—Independent steel manufacturers consider policy to be adopted in future dealings with jobbers. Connellsville furnace coke for immediate shipment offered at new low price of $1.35, ovens.

10—Monthly statement of Steel Corporation shows further decline in unfilled tonnage on books. Norfolk & Western and Erie railroads each place orders for 32,000 tons steel rails for 1911.

11—Agricultural implement makers in the middle west order more freely and the mills receive specifications covering shipments for first three months 1911.

12—Bi-monthly examination of sales sheets shows a 1.35c bar iron card, meaning reduction of 25 cents a ton in the puddlers' wage scale for November and December.

14—Pittsburg Steel Co. plans increasing capital stock from $6,000,000 to $14,000,000, and authorizes the construction of two blast furnaces at Monessen, Pa.

15—Several large consumers of furnace coke in the Pittsburg territory close for full requirements over 1911, aggregating 60,000 tons per month.

16—Iron and steel manufacturers encouraged by election results throughout the country and more general buying of pig iron follows.

17—Great Lakes Protective Association op-

posed to extension of insurance policies on lake vessels after Nov. 30.

18—Youngstown Iron & Steel Roofing Co. changes the corporate title to the Youngstown Iron & Steel Co., and announces the completion of a new jobbing mill, etc.

19—Steel Corporation acquires exclusive right in the United States for the manufacture and refining of steel under Heroult patents. Andrew Carnegie donates $2,300,000 for new buildings and equipment of the Carnegie Technical Schools at Pittsburg.

21—Retail hardware dealers in Pittsburg organize American Hardware & Supply Co., to act as a distributing agency for retail merchants.

22—Carnegie Steel Co. cuts the price of structural beams from store at Waverly, N. J., warehouse to 1.70c for shipment and 1.80c for immediate territory.

23—Directors of New York Central authorize orders with the American Locomotive Co. for 323 locomotives for 1911.

24—Quotations on Connellsville furnace coke show slight advance and some contracts of good size are made with furnace interests. Consuming furnace interest in Pittsburg closes for its full requirements, aggregating 720,000 tons for two years, on a sliding scale basis.

25—Steel Corporation operating 55 per cent of its actual blast furnace capacity, represented by 119 stacks. Stacks in the middle west outside of the Steel Corporation amount to about 835,000 tons.

26—Pennsylvania Railroad Co. announces making allotment for 150,000 tons of steel rails for 1911 delivery.

28—Pittsburg Steamship Co. authorized to proceed with construction of two large ore freighters for 1911 delivery.

29—Plans are consummated to begin paying, on Jan. 1, pensions from joint Steel Corporation and Carnegie pension fund. Steel companies refuse to accept rail orders of the Pennsylvania Railroad Co. account specifications.

30—Directors of American Iron and Steel Institute decide that a general reduction in prices of finished lines would not bring out any additional business at this time.

DECEMBER.

1—Plant of Lebanon Valley Furnace Co., Lebanon, Pa., and one ninety-sixth interest in Cornwall ore banks purchased by J. M. Shenk and George Meily, of Lebanon.

2—Canvass of 3,000 members of the National Association of Manufacturers shows business is only fair.

3—F. B. Richards, of Cleveland, elected president of Lake Superior Ore Association, succeeding W. G. Mather. Pig iron market continues quiet.

3—Small mills west of Pittsburg cut price of forging billets $3 a ton and prices of crude steel, sheets, wire and nails $1 a ton.

5—Steel companies submit bids on approximately 30,000 tons of shapes and plates for new boat construction.

6—Indictments against 16 firms and 32 individuals making enameled cast iron sanitary ware by the federal grand jury in Detroit.

7—Reports Steel Corporation contemplate drastic reduction in its labor force, officially denied by Judge E. H. Gary.

8—Manufacturers of sheets in Pittsburg decide a general reduction in prices would not bring out additional business.

9—Reports show that the season just closed was one of small profits for many lake vessels.

10—Alan Wood Iron & Steel Co. authorizes construction of third furnace at Hecksher plant.

12—Manufacturers of rails and structural steel meet, being first of series of meetings called by chairmen of the various branches of the American Iron and Steel Institute.

13—Structural steel tonnage offered to manufacturers and fabricators so far this year estimated at 175,000 tons, equal to 1906. Canadian steel car company awards contract to Carnegie Steel Co. for 20,000 tons material.

14—Manufacturers of crude steel in Pittsburg decide to quote billets and sheet bars f. o. b. makers' mill, Pittsburg or Youngstown, full freight to destination added, instead of f. o. b. Pittsburg.

15—President W. C. Brown, of New York Central, announces that the rail order of this company for 1911 delivery will be 150,000 tons.

16—Judge E. H. Gary announces that directors of the United States Steel Corporation have set aside $2,700,000 for distribution as bonus to employes.

17—Reports show that iron ore receipts at Lake Erie ports during 1910 were 34,042,897 tons and that shipments to furnaces between May 1 and Dec. 1 amounted to 30,060,096 tons.

19—Advance reports show that bookings of the American Bridge Co. for the year will be about 425,000 tons, representing about one-third of the work placed.

20—Order for 153 locomotives placed with Baldwin Locomotive Works by Harriman lines.

21—Carnegie Steel Co. awarded a contract for 10,000 tons of plates for the hull of the new battleship to be built at Newport News. First of 10 steel barges of the United States Steel Corporation built by the American Bridge Co. launched. Manufacturers of foundry pig iron meet in Cleveland to discuss trade conditions.

22—To a greater extent than usual, dullness characterizes the holiday and inventory period.

23—Operating blast furnaces of United States Steel Corporation banked for holidays.

24—Connellsville coke producers announce application will be made for charter for the Fidelity Coal & Coke Co., capital $300,000, to handle output of 7,000 ovens.

27—Corrigan-McKinney & Co. close for between 20,000 and 30,000 tons of Connellsville furnace coke for January shipment at $1.40, ovens, and an equal amount for each of the remaining five months of the first half of 1911 at $1.60, ovens.

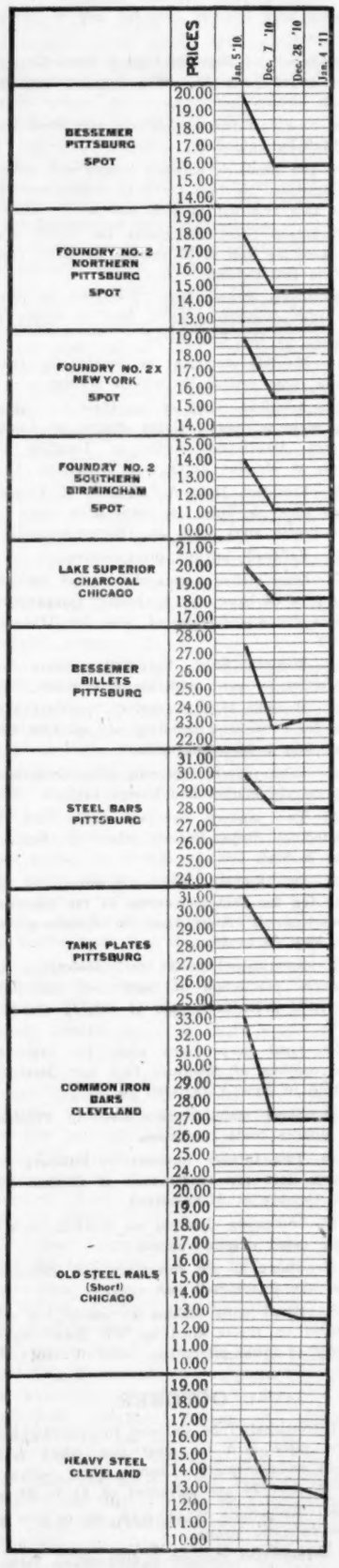
28—Judge E. H. Gary, president of American Iron and Steel Institute, invites iron and steel manufacturers to attend a dinner conference in New York, Jan. 9.

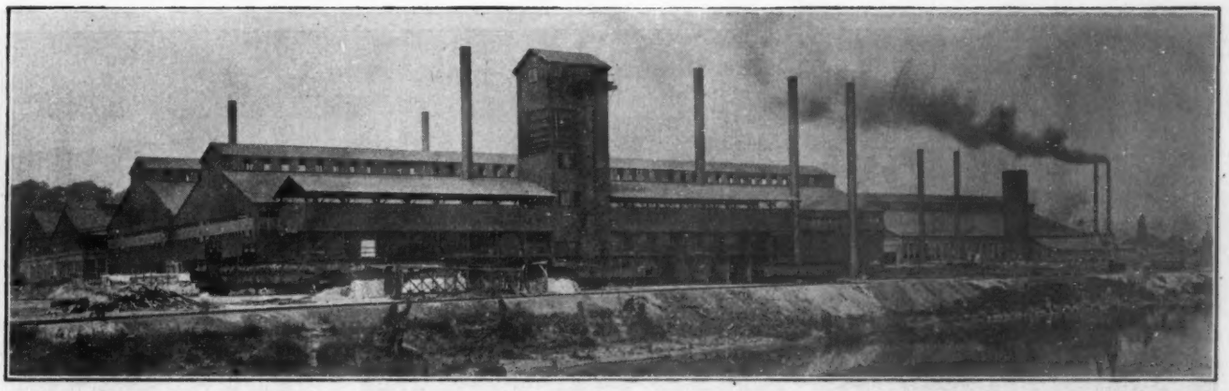
29—Newport News Ship Building & Dry Dock Co. awarded contracts for two additional freight boats requiring 1,500 tons of plates each.

30—Basic pig iron manufacturers hold second meeting in Cleveland to discuss plans for formation of selling association to represent furnaces in Mahoning and Shenango valleys.

31—A surprisingly large number of manufacturers report that 1910 has been a record year with them. The year closes with a large number of steel mills idle and with buyers giving little attention to early requirements.

PRICE CHART





New Tube Mills of the Republic Iron & Steel Co.

A Modern Plant Covering the Entire Cycle of Operations in the Manufacture of Tubular Products From Ore to Finished Pipe

An important addition to the finishing capacity of the country, completed during the year 1910, was the new tube works of the Republic Iron & Steel Co. This company during the year 1908-1909 increased its skelp production by building and putting into operation two new skelp mills at its Brown-Bonnell works, Youngstown, O., and in May, 1909, its executive committee authorized the construction at Youngstown of a tube works consisting of two butt weld and two lap weld mills to make merchant and line pipe, casing and other welded tubular goods from ¼ inch up to 12 inches diameter, the butt weld mills to be designed to cover between them the range of sizes from ¼ inch to 3 inches, inclusive, and the lap weld mills the range of sizes from 2 to 12 inches, inclusive. The authorization of the building of this plant was notable as there then existed only one other producer of tubular goods owning the necessary raw materials and plant to control the process from the ore to the finished production in both Bessemer and open-hearth steels.

Rapid Construction of Plant.

Immediately upon the authorization of construction, the work of designing, building and organizing the plant was vigorously attacked and in April, 1910, the first butt weld mill was put in operation, the other mills following, and by July, 1910, all departments had been operated and all sizes of merchant pipe within the above limits had been made. The plant has now been producing all sizes of pipe for about six months, shipping its product regularly to the trade and, while business conditions have precluded full operation, shipments have steadily increased up to the present time and are now close to those of other tube plants in percentage of shipments to capacity.

Favorable Location and Large Capacity.

Since the first day's operation there have been no breakdowns and practically no starting-up troubles, good production, low scrap loss and freedom from complaints from customers being maintained on such units as have been operating. These results, somewhat exceptional in a new plant, have been attained by substantial construction, long experience in providing proper raw material and an experienced operating organization. The results thus far attained show a probable production of 10,000 to 12,000 tons per month under good business conditions and full operations.

The site chosen for the tube works was part of a plot of ground owned by the Republic Iron & Steel Co., situated on the bank of the Mahoning river, opposite its Hazelton furnaces, and about a mile below its Brown-Bonnell works. On another portion of the same property is now building and has almost completed a modern open-hearth plant, blooming mill and billet mill. All of these plants are connected together by the company's own railroads and bridge, providing cheap inter-departmental movement of hot metal, billets, skelp, etc. The site also has connections, either direct or through one of the other plants, with all railroads in the Youngstown district, which includes the Pennsylvania and Lake Shore systems, Baltimore & Ohio and Erie railroads. The proximity of the site to the company's other operations made unnecessary the construction of any large power plant at the tube works, all power for the plant being electric current generated from blast furnace gas at the Haselton furnaces by an extension of the existing steam power plant at that point, the use of steam in the tube works being confined to blowing producers, heating and finishing departments and a few minor uses.

All machinery in the tube works is driven by individual direct connected direct current motors and care was taken to install motors amply large for the service and to use as many duplicate motors as possible. Fly wheels are provided on the motors at the welding rolls and on other machines where heavy loads of short duration occur. So far as possible the motors were placed in positions where they could be easily cared for and away from the heat of the furnaces. The total number of motors installed in the plant was 199, totaling 2,450 horsepower.

Arrangement of Plant.

In the design and construction of the plant every effort was made to properly protect the machinery and to guard against accidents or personal injury. Gear covers and guard railings were provided at all exposed points and the plant was inspected for risks by the company's corps of accident inspectors before starting up.

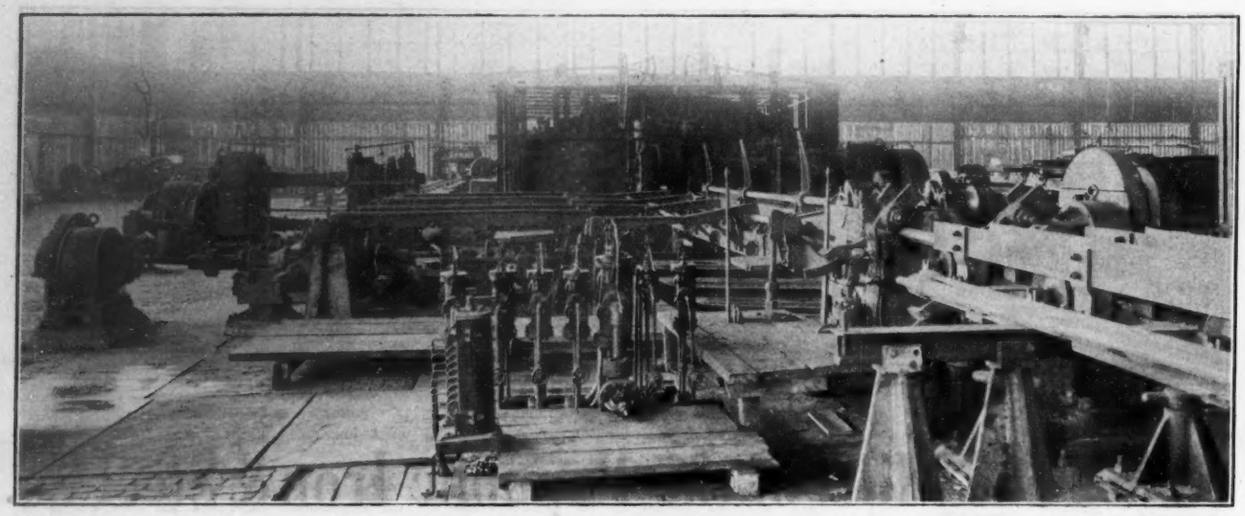


FIG. 1—LAP-WELD FURNACE.

The accompanying illustrations show the general layout and appearance of the plant which was designed with a view to the best use of the property available and to permit of indefinite extension. The main buildings consist of four parallel bays, a skelp bay, a furnace bay, a threading bay, containing at one end the galvanizing department, and a shipping bay or warehouse. This plan permits of the addition of units without interference to operation. The skelp and furnace bays are high, roomy buildings of the ordinary rolling mill type, of steel construction, with ample air space to insure as far as possible comfortable working conditions at the furnaces in summer. The threading bay and shipping bay are lower steel frame buildings of the factory type, with brick sides, so as to be more easily heated in winter. The skelp bay, threading bay and shipping bay are well provided with electric cranes and the furnace bay with individual electrical trolleys at all points where necessary. Space was left between the furnace bay and the threading bay to permit of good ventilation of the former during hot weather. The subsidiary buildings, consisting of the machine shop, socket shop, producer building, office, etc., are placed as shown on the plant either out of the line of extension of the main buildings or at a reasonable distance from them. The total area of buildings under roof is about 5 acres; of the warehouse alone about 54,000 square feet.

Process of Manufacture.

The furnace equipment consists of two butt-welding furnaces for the two butt-weld mills and two bending and two lap-welding furnaces for the two lap-weld mills, together with two socket furnaces. All of these are of the ordinary Siemen's regenerative type, strongly built, with large regenerative areas. Gas is furnished by 18 water-seal gas producers housed in a separate steel building provided with complete crushing, elevating and distributing machinery providing for the economical handling of fuel.

The general movement of the lap-weld material is as follows: It is delivered from the rolling mill on the track under the crane in the skelp bay, is handled by this crane and placed at the skelp charging machines, is charged, heated, scarfed and bent, rolls down into the pit of the welding furnace, is charged by machine, welded in the welding rolls, transferred to the sizing rolls, is sized and then straightened in the cross rolls, cools and is delivered from the cooling bed to the threading bay by conveyor, where it is handled by cranes during the various finishing operations of cutting off, threading, testing, etc. At all times the material is either under traveling cranes where it can be handled in bulk or on an electric charging machine, transfer or conveyor, where it can be handled economically by the piece. The general movement of butt-

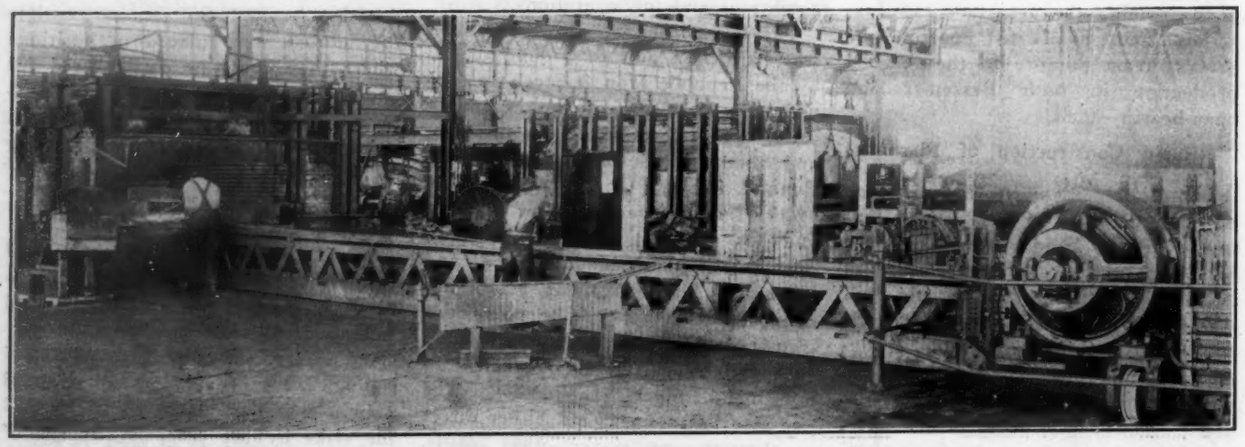


FIG. 2—BUTT-WELD FURNACE.

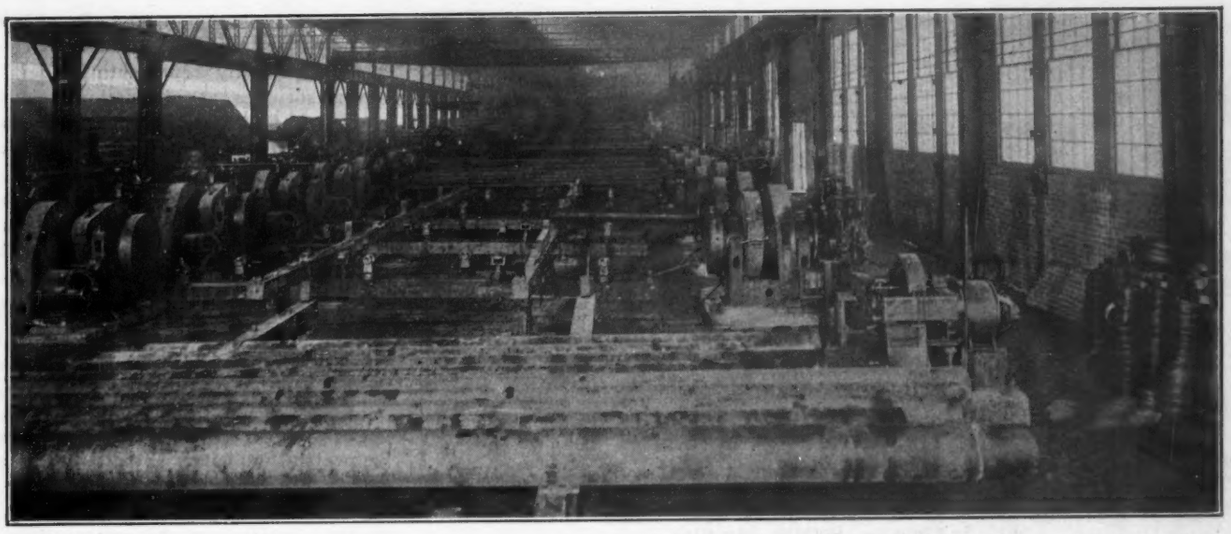


FIG. 3—THREADING FLOOR.

weld pipe is similar in principle but with changes due to the difference in the processes.

Each mill is provided with a full complement of motor-driven cutting-off, threading, coupling-screwing-on machinery and hydraulic testing benches, so that each can be run as a separate unit if necessary and so arranged that the material can move promptly through the various operations from the skelp bay to the warehouse or shipping bay as promptly as possible and without the accumulation of unfinished pipe. Hydraulic testing is done by water pressure furnished by motor-driven pumps working against a hydraulic accumulator, the various pressures necessary being obtained from the pressure water by individual intensifiers at the testing benches. By this system all pipe tested receives a definite test pressure, irrespective of anything which the operator at the testing bench can do and have on this account certain advantages in definiteness over the ordinary individual steam pumps. All service water for the plant is taken by means of motor-driven pumps from the river, pumped over a stand pipe and distributed where needed.

The galvanizing department of the plant is situated at one end of the threading bay and consists of one galvanizing pot with its complement of acid and water tanks, threading machinery, testing machines, etc., and is covered by an electric traveling crane.

Making Couplings.

Scales are placed wherever necessary so that the amount of material charged and finished may be accurately determined and the furnace, scrap and other losses kept for accounting purposes.

In the coupling shop small sockets up to ¾ inch are made and finished from the solid bar in automatic screw machines. Larger couplings are made from socket iron in roller welding machines and tapped in vertical multiple spindle tapping machines. A complete oil distributing and recovery system is installed in the coupling shop.

A complete machine, pattern and blacksmith shop is also provided with motor-driven tools sufficient for the upkeep of the plant and for making the necessary taps, dies, etc.

The plant was entirely designed, built and organized by the operating and engineering department of the Republic Iron & Steel Co., and without any outside assistance.

The Schuylkill Haven rolling mill, near Pottsville, Pa., has been acquired by a party of capitalists headed by J. S. Hanthere, of Wilmington, Del., who is on the ground directing the work of rehabilitating the property. It is stated that the mill will be put in operation shortly after the first of the year. The plant has not been running for several years.

FIG. 4—COUPLING SHOP.

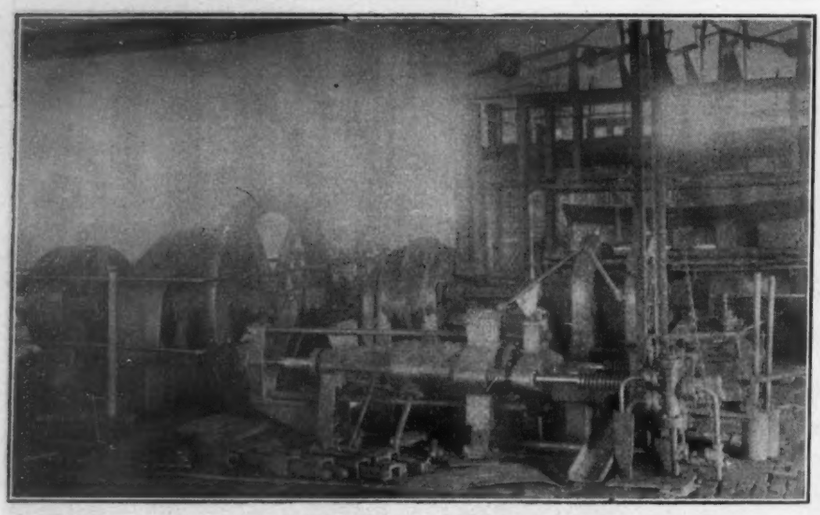


FIG. 5—COUPLING ROLLING MACHINE.

Death of G. C. Henning

Gustavus Charles Henning, prominent as an expert in the testing of steel and the inventor of testing apparatus, died at his home in New York City, Dec. 30, at the age of 55 years. He was a member of the International Association of Testing Materials, the American Iron and Steel Institute, the British Iron and Steel Institute, the American Society of Mechanical Engineers, the American Society for the Advancement of Science, the American Institute of Mining Engineers and of other technical organizations. Mr. Henning was born in Brooklyn in 1855 and was educated at Brooklyn Polytechnic Institute and at Stevens. He was inspector of material upon the Brooklyn bridge. He traveled abroad extensively, frequently representing engineering societies at international congresses and he introduced American testing machines, some of them of his own invention, into foreign industries. He began in 1898 to translate from the German Prof. Marten's work upon "Testing Materials of Construction," and it was through overwork in this translation that his final illness was brought on.

Publicity Association

The annual banquet of the Manufacturers' Publicity Association was held at the Fort Pitt hotel, Thursday evening, Dec. 29. Richard H. Waldo, secretary of the eastern division of the Associated Advertising Clubs of America; Herbert S. Houston, chairman of the executive committee; J. C. McQuiston, manager of the Westinghouse publicity department; C. B. Nash, assistant advertising manager of the Standard Sanitary Mfg. Co.; W. A. Keirn, of the Mesta Machine Co., and Clover Gordon, president of the association, were the principal speakers.

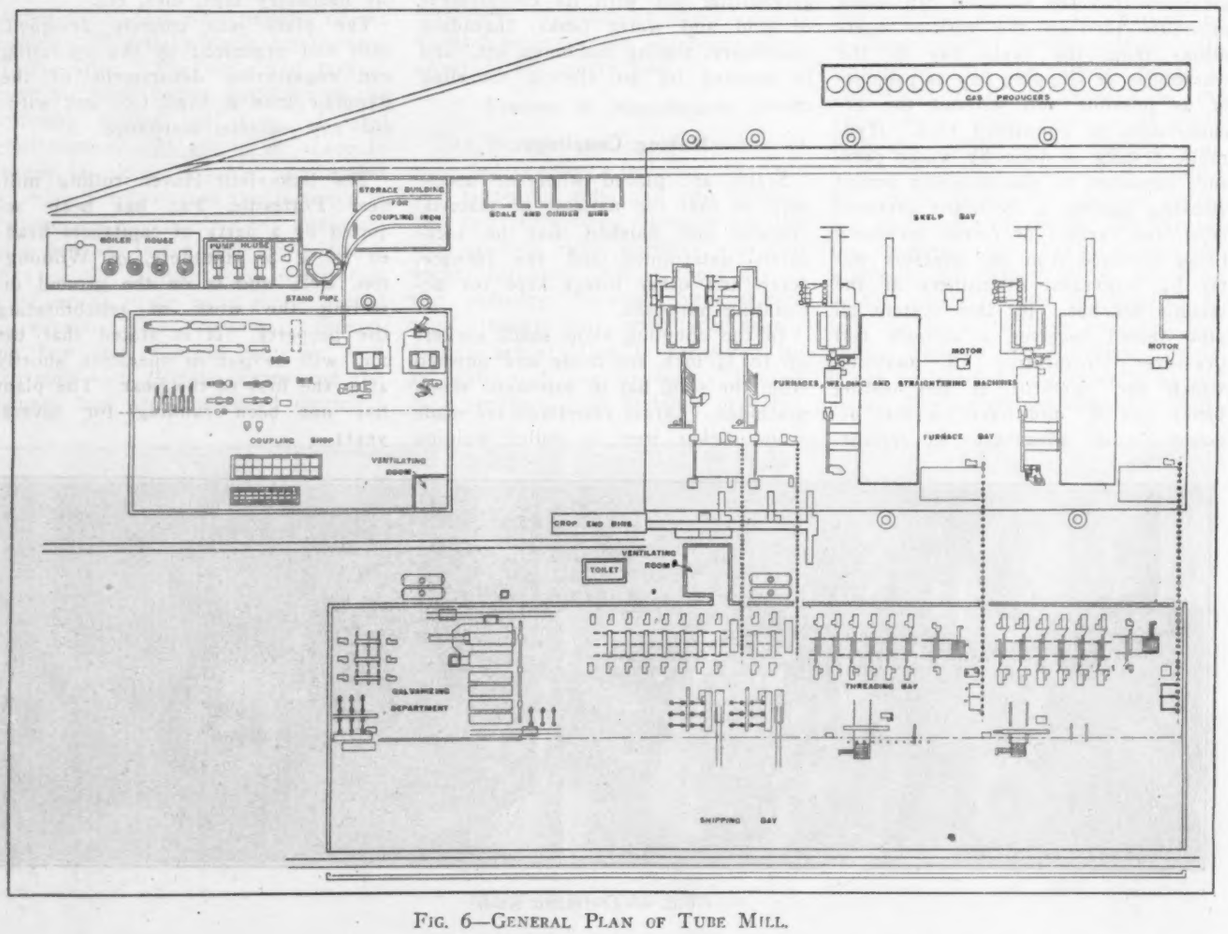


FIG. 6—GENERAL PLAN OF TUBE MILL.

The West Optimistic in Spite of Declining Prices

Chicago Market Generally Weak Throughout Year, but Cheerful Feeling Prevails—Lower Prices in All Lines—Little Railroad Buying

By H. Cole Estep.

Buoyancy and optimism are prominent American characteristics and the west is particularly noted for its cheerfulness in the face of difficulties or unexpected situations. This spirit came nobly to the rescue in supporting the tone and morale of the iron trade in the west throughout the entire past year of falling prices and disappointed hopes. The dawn of the new year finds prices seeking new low levels and business in all iron and steel products unusually quiet; yet the west is facing the situation cheerfully, with a steadfast hope of better things to come which even another season of slow business and small profits could not shake.

Nineteen hundred and ten broke on the Chicago market with a fanfare of trumpets proclaiming a year rich with promise. In January, prices were firm and mills were crowded with business. Northern No. 2 foundry pig iron was selling for $19, Chicago, a price exceeded during only three brief periods in 15 years. Tank plates and shapes were 1.78c, bar iron was 1.60c, Chicago, and other prices were in proportion. But instead of increasing activity and stronger prices, the year witnesses a perceptible slowing up in the rate of production and a steady decline in quotations. December found No. 2 northern pig iron $16 per ton, or $3 lower than in January, with this figure acceptable for deliveries extending at least through the first quarter of 1911. Tank plates were quoted 1.53c in the Chicago market in December, registering a net decline of $5 a short ton during the year, and bar iron touched 1.30c, $6 a ton under the price at the opening of the year. Other iron and steel commodities weakened in about the same ratio. Charcoal iron was the stiffest of the crude products, declining only $2 a ton, and wire prices were the most effectively maintained among finished materials, dropping but $3 a ton. A review of the Chicago market, printed in these columns a year ago, likened it at that time to "a giant refreshed with wine." The temporary strength exhibited early in 1910 was not wholly unlike that which springs from intoxication, with the market at present barely recovering from the after effects.

It has been a difficult season for selling organizations, and for the records that have been achieved, many of them noteworthy, double credit should be given, for they were accomplished on a falling market which lends no support whatever to the salesman, forcing him to rely absolutely on his own resources.

Pig Iron Conditions.

A year ago, both sellers and buyers of pig iron generally expressed confidence in the strength of the market. The question was not whether quotations would be advanced, but how high would the figures go. January witnessed a buying movement of good proportions, during which time the furnaces disposed of heavy tonnages. Inquiry was heavy and much of it was for the last half of the year, or as far ahead as the buyer could obtain quotations, showing that purchasers in general did not expect lower prices. Southern iron improved perceptibly during January.

This condition extended into February and the first week of the second month witnessed active trading, including the sale of a block of 15,000 tons of malleable.

About Feb. 10, the first signs of weakening appeared and from that day to this, minor fluctuations excepted, the course of the market has been steadily downward. The first break in February was the result of the natural sequence of events and of external influences, among which may be mentioned over-production, railroad rate questions, wage problems and governmental interference, all of which combined to produce a hesitant and apprehensive feeling in general business. After the heavy buying of the previous weeks, a pause was the natural thing to expect during the latter part of February. A natural reaction often follows a buying movement. But in the market during 1910 other weakening influences, a few of which have been suggested, were at work accelerating the decline at every point. Thus prices were pushed lower after each buying movement than they would go merely from the natural reaction, leaving quotations at successively lower levels following each of the minor fluctuations of the market. The effect of this continual hammering was cumulative, adding to the weakness of the situation, while all the time the strength of the external depressing influences became more and more apparent. On a rising market, prices climb higher and higher on each buying movement, but, with conditions reversed, each little period of quietness brings out lower quotations, due to the influences pointed out above. Events follow their downward course until external conditions produce a change in sentiment which permits the market to recoup its losses. Just when this change in sentiment will come is very difficult to foretell and very important to know.

"Has the bottom been reached?" This was the all-important question

AVERAGE MONTHLY PRICES—CHICAGO MARKET, 1910.

Commodity.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Lake Superior Charcoal, Pig Iron	$19.50	$19.50	$19.00	$19.00	$19.00	$18.50	$18.50	$18.50	$18.50	$18.00	$18.00	$17.50
Northern No. 2 Foundry Pig Iron	19.00	18.75	18.25	17.00	16.75	16.50	16.50	16.50	16.50	16.00	16.00	16.00
Southern No. 2 Foundry Pig Iron	18.35	18.10	17.85	16.35	16.35	15.85	15.85	15.35	15.35	15.35	15.35	15.35
Bar Iron, mill	1.60c	1.60c	1.55c	1.55c	1.48c	1.45c	1.40c	1.38c	1.38c	1.35c	1.35c	1.32c
Steel Bars, mill	1.68c	1.68c	1.63c	1.63c	1.63c	1.63c	1.63c	1.58c	1.58c	1.58c	1.58c	1.53c
Structurals, mill	1.78c	1.78c	1.73c	1.73c	1.68c	1.63c	1.63c	1.58c	1.58c	1.58c	1.58c	1.58c
Plates, mill	1.78c	1.78c	1.73c	1.68c	1.68c	1.63c	1.58c	1.58c	1.58c	1.58c	1.58c	1.53c
Sheets, No. 28 Black, store	3.00c	3.00c	3.00c	3.00c	3.00c	3.00c	3.00c	2.85c	2.85c	2.85c	2.75c	2.75c
Plain Wire, carloads to jobbers	1.83c	1.83c	1.83c	1.83c	1.83c	1.83c	1.73c	1.73c	1.68c	1.68c	1.68c	1.68c
Wire Nails, carloads to jobbers	2.03c	2.03c	2.03c	2.03c	2.03c	2.03c	1.98c	1.93c	1.88c	1.88c	1.88c	1.88c
No. 1 R. R. Wrought Iron, gross ton	$14.75	$14.75	$14.25	$13.50	$12.75	$12.75	$12.75	$12.00	$12.00	$12.00	$11.75	$11.50
Heavy Melting Steel, net ton	16.00	15.50	14.50	14.50	13.00	13.00	12.50	12.25	12.25	12.25	12.00	12.00
Rerolling Rails, net ton	17.75	17.75	17.50	17.50	17.25	16.50	16.50	15.50	15.75	15.75	15.00	14.00

during the year. There is plenty of evidence that in answering this question, even the best informed go astray. At several points last year, the assertion was confidently made, based on good authority, that pig iron prices had in all probability reached their lowest point. Yet each time prices went lower. Evidently the real turning point in the situation is either just at hand or still in the future.

Some Buying in March.

During the February reaction, pig iron prices declined only 25 cents. March opened with the market hopeful, confident that the recent slump had been nothing more than a natural reaction and that prices could not go lower. Not a few thought the bottom had been reached before the decline had fairly started. Some heavy buying took place in March, including the purchase of upwards of 30,000 tons by the leading radiator interest, nevertheless prices declined and the month closed with northern No. 2 at $18.75 and southern at $17.85, Chicago.

The second quarter found the pig iron market well started on its downward course. By the end of June, northern iron was quoted freely at $16.50, and southern at $15.85, for delivery up to Oct. 1. Over-production was evident and blowing out was freely discussed as a feasible remedy, but not accepted as a practical measure. Furnace stocks increased perceptibly as a result.

Lower Prices Resisted.

In the second half, the Chicago pig iron market resisted the tendency toward lower prices much more successfully than it did earlier in the year. This indicated real strength, for naturally the momentum of the decline made the pressure forcing the market downward much more severe. Buyers had grown accustomed to being treated to lower quotations. Nevertheless pig iron prices dropped only 50 cents a ton during the second half, while the reductions during the first six months of the year amounted to $2.50.

The summer was quiet, but in August the big deal of the second half appeared in the shape of an inquiry for upwards of 40,000 tons of various grades of iron from the Oliver Chilled Plow Works. This tonnage was purchased late in the month. Close prices were made, for delivery throughout the first half of 1911. This purchase stimulated a buying movement of moderate proportions, but had no beneficial effect on prices.

Previous to September, furnaces had been generally very reluctant to quote for 1911 delivery, but during this month first quarter quotations were made freely. An advance of 50 cents a ton over prices prevailing for prompt shipment was asked at first, and a comfortable tonnage was sold on this basis. But the market was not strong enough to maintain the premium, which gradually dwindled away, until it disappeared in December.

October and November were active months, it being estimated that more iron was sold during November than in any previous month since December, 1909. The feature of the October market was the purchase of several blocks of basic, amounting in all to 38,000 tons, by the Inland Steel Co. A very large part of this iron came from Lake Erie furnaces by water and was delivered at the dock at Indiana Harbor for $14.65 per ton.

December was quiet, with both buyers and sellers in a waiting mood. Premiums for future delivery disappeared and quotations for prompt shipment applied equally well over the first quarter. Lake Superior charcoal excepted, prices were well maintained during the final month of the year.

Conditions Similar in all Lines.

The story of the year in pig iron has been told somewhat in detail, because its movements were typical of the market generally. The price table published herewith is more eloquent than words in indicating conditions in finished materials. Early in the year, the mills were so crowded with business that deliveries were slow and premiums were paid for early shipments. But this condition wore away during the first half, while the relatively small volume of new business taken caused declines in prices.

Rail Sales.

Rail sales were heavy in January, March, May and October, but the orders received were considerably less than rolling capacity. Specifications were fairly regular. Late in the year, the extreme reluctance exhibited by railroads in placing orders for their 1911 requirements began to be very apparent.

Structural material was generally active in the west throughout the year, and at times showed independent strength. Fabricators were well supplied with work and the records achieved in this line are generally satisfactory. At the close of the year, well posted authorities estimated that over 275,000 tons of structural material was involved in work projected in the west for 1911.

Plate Market Quiet.

Car building was light during the year and a generally declining market for plates was observed. The mills were very busy during the first half filling specifications on old orders. By summer, conditions had changed and in June it was reported that "considerable expansion in the demand for plates could be experienced without embarrassing the capacity of the mills." Light business characterized the plate market during the third and fourth quarters.

Generally similar conditions prevailed in the lighter finished lines, except that the agricultural demand in the west and south maintained the sales of wire products at a comparatively satisfactory point.

New Construction.

A complete chronicle of the new construction in the middle west during the year would fill this issue. A few items only can be mentioned. At Gary, the axle mill was completed while work continues on the plate and bar mills, one additional battery of open-hearth furnaces, the coke ovens, the American Bridge Co.'s works and the American Sheet & Tin Plate Co.'s plant, which is now nearing completion. In the immediate Chicago district, the Continental Bolt & Iron Co. built a plant for the manufacture of bolts and nuts; the Inter Ocean Steel Co. finished its works for rolling tires and heavy rings; the Pullman Co. completed its freight car shops; the Inland Steel Co. finished eight new sheet mills, making 18 in operation in all, and the Iroquois Iron Co. commenced the construction of two new blast furnaces. The Scully Steel & Iron Co. moved into its new warehouse on Ashland avenue and Twenty-fourth street, Chicago, on March 19.

Doubtful if Lower Prices Would Help.

Some authorities are pointing out that at present conditions are similar to those prevailing just previous to the declaration of an open market in February, 1909. This is undoubtedly true, with one important exception. In 1909, finished steel beams, plates, etc., were quoted 1.60c Pittsburg, while today the level of the market is $4 a ton lower. For this reason it is considered doubtful whether abrupt reductions would stimulate business at this time.

The Continuous Manufacture of Cast Iron Pipe

Straight Line System for the Production of Water Pipe—All Operations Continuous From Molding to Shaking-Out

By A. O. Backert.

AS THE manufacture of cast iron pipe is almost entirely repetition work, involving large tonnages, pipe foundrymen are installing continuous systems of various types, not only to effect economies in operation and to improve the quality of the product, but also for the purpose of minimizing the arduous hand labor of this line of work, which makes it difficult to retain a full quota of men in these plants, particularly during the summer months. One continuous molding and casting plant installed by the United States Cast Iron Pipe & Foundry Co., in its Scottdale, Pa., works, is designed on the circular floor plan, the flasks rotating on a turntable for the successive steps of molding, coring, pouring, shaking-out, etc. Electric rammers are used for making the molds and hand labor is largely eliminated. The objection raised against this, as well as against other circular, continuous systems is that a delay, or accident at any point, either delays or stops the entire cycle of operations.

When James B. Clow & Sons, Chicago, decided to erect a pipe foundry at Coshocton, O., an investigation was made of all the American and European continuous systems of cast iron pipe manufacture. The works of Cochrane & Co., Ltd., Middlesborough, Eng., were one of the numerous plants visited by C. M. Aland, superintendent of the Coshocton foundry, who conducted the investigation for the Clow company. In this plant large sizes of water pipe are successfully made by a straight line, continuous process, devised by Fred Herbert, of Birtley, Eng., and as it embodies none of the objectionable features of some of the circular systems investigated, it was concluded to operate the Coshocton foundry by this method. As each flask is self-contained and is not attached to any part of the plant, or structure, there are no vexatious delays due to accidents, or other causes, which so frequently delay the operation of circular, continuous systems. If it is found necessary to remove one of the flasks forming a part of the Herbert system, the unit can e lifted out by a crane without impeding the forward movement of the other flasks, or retarding operations.

A diagrammatic illustration of the successive operations of pipe manufacture by the Herbert process, is shown in Fig. 9. The flasks, which are vertically suspended from four parallel tracks, are mounted on four wheels fixed on axles, forming a truck, on which each flask is carried. The flasks are longitudinally divided into two sections, and each half is carried on a small wheel operating on the upper side of each axle, so as to permit of opening the flask when shaking-out the casting. The rails are on a level with the foundry floor and the flasks are suspended in a pit extending the entire length of the continuous plant, in which are also located the hydraulic molding machine, gas burners for drying the molds and the sand tempering and preparing plant. The hydraulic machine is shown in this illustration, and after the flasks are shaken-out and closed, they are moved forward on the track to this point, lowered onto the base of the machine, sand is filled-in around the measuring tube and the mold is rammed by the upward movement of the hydraulic piston of the molding ma-

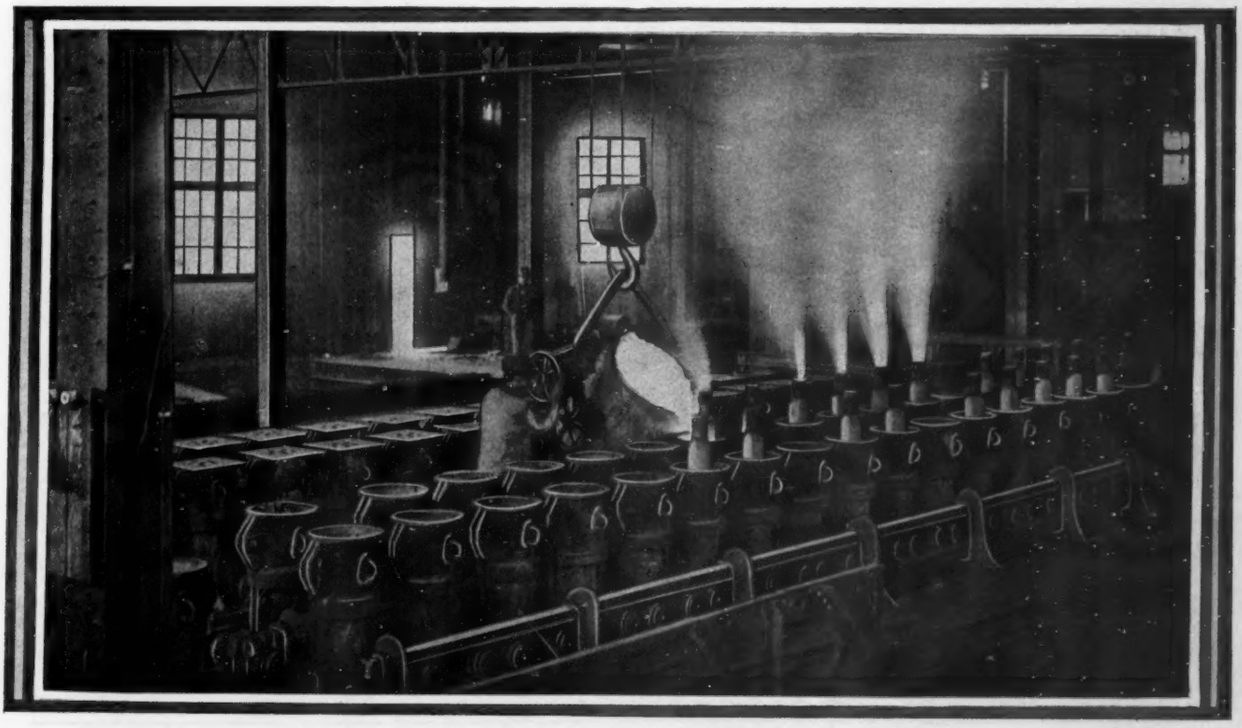


Fig. 1—Continuous Cast Iron Water Pipe Manufacturing Plant, Showing the Method of Pouring the Molds.

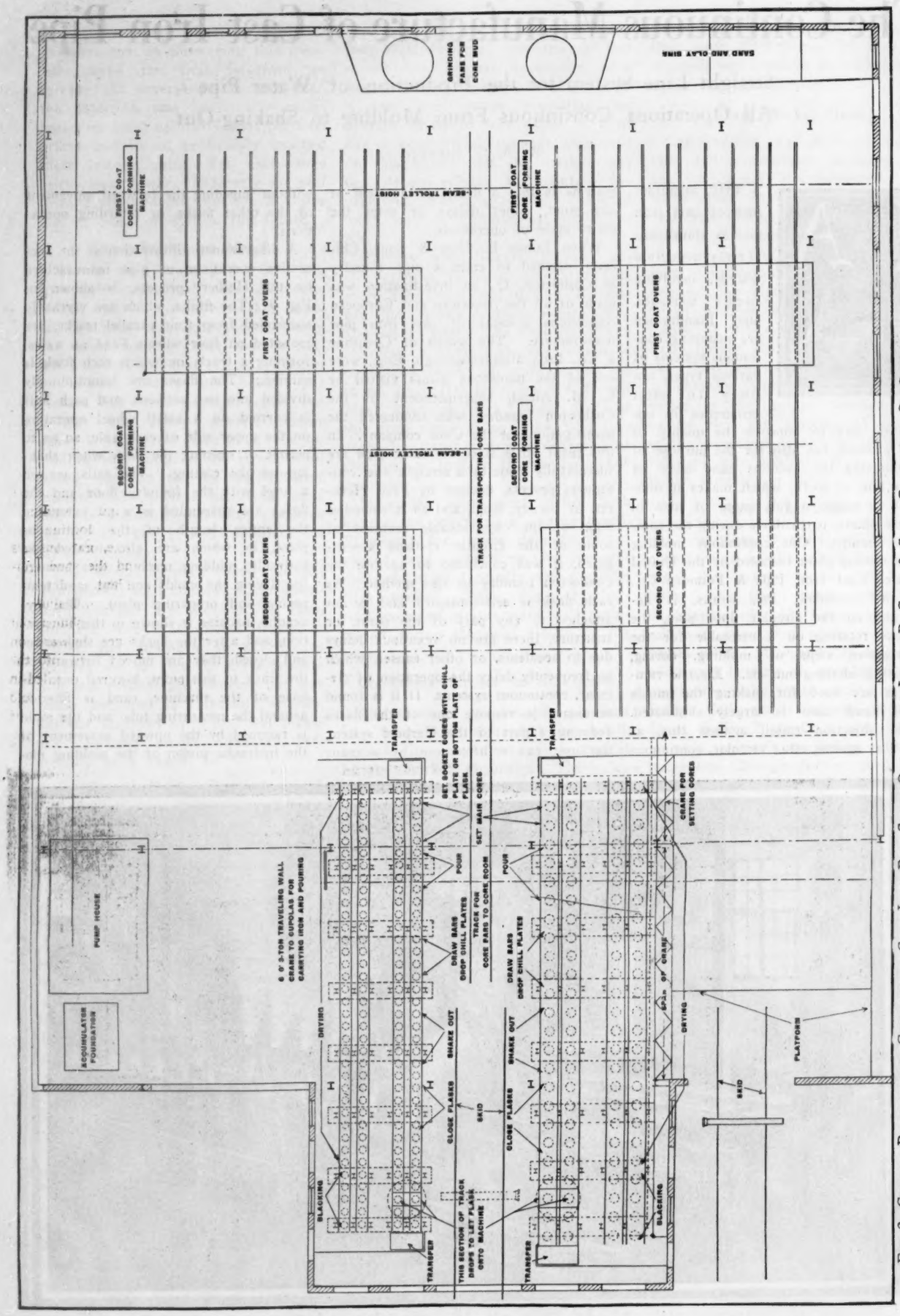

GRINDING PANS FOR CORE MUD
SAND AND CLAY BINS
FIRST COAT CORE FORMING MACHINE
SECOND COAT CORE FORMING MACHINE
I-BEAM TROLLEY HOIST
FIRST COAT OVENS
SECOND COAT OVENS
TRACK FOR TRANSPORTING CORE BARS
TRANSFER
SET SOCKET CORES WITH CHILL PLATE OR BOTTOM PLATE OF FLASK
SET MAIN CORES
POUR
TRACK FOR CORE BARS TO CORE ROOM
DRAW BARS DROP CHILL PLATES
CRANE FOR SETTING CORES
6 0' 5-TON TRAVELING WALL CRANE TO CUPOLAS FOR CARRYING IRON AND POURING
PUMP HOUSE
ACCUMULATOR FOUNDATION
DRYING
SHAKE OUT
CLOSE FLASKS
SKID
BLACKING
THIS SECTION OF TRACK DROPS TO LET FLASK ONTO MACHINE
PLATFORM

FIG. 2—GROUND PLAN OF THE CONTINUOUS CAST IRON PIPE SHOP, OPERATED BY JAMES B. CLOW & SONS, COSHOCTON, O., SHOWING THE ARRANGEMENT OF THE MOLDING AND CASTING PITS, CORE OVENS, CORE FORMING MACHINES, ETC.

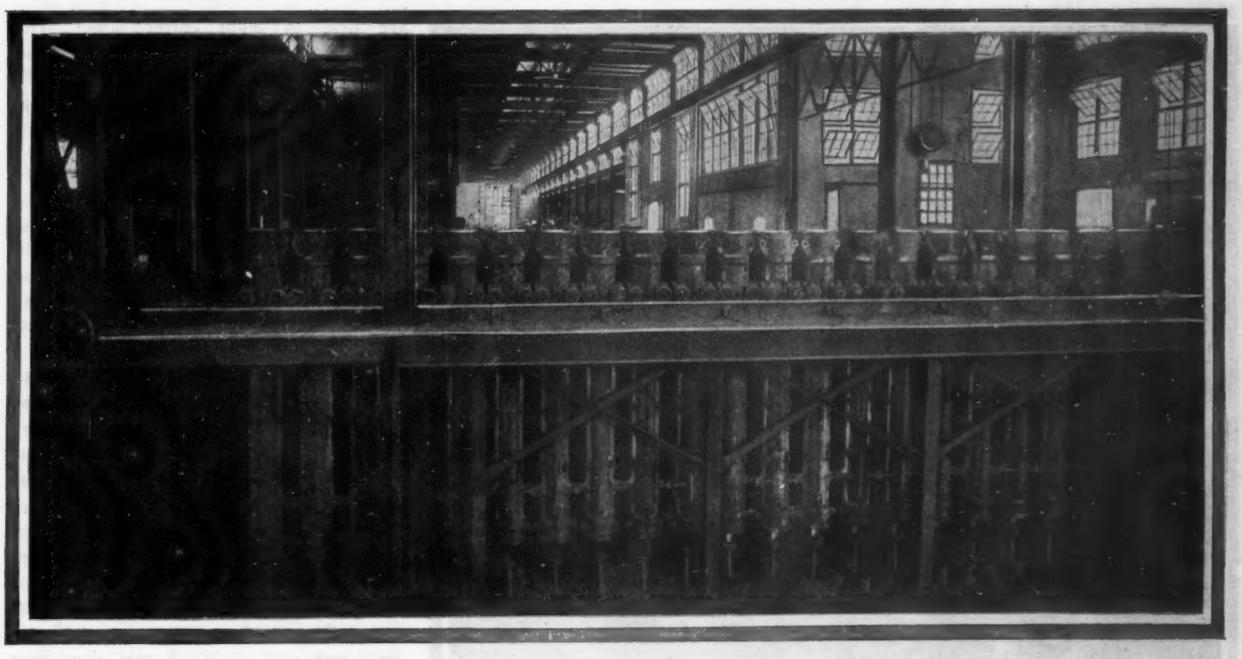


FIG. 3—VIEW OF THE MOLD DRYING TRACK AND THE ARRANGEMENT OF THE CONTINUOUS PIPE MANUFACTURING PLANT, LOOKING TOWARD THE GRAY IRON FOUNDRY.

chine. The mold is then moved forward onto a transfer car operating on a track at right angles to the main runway, and extending the width of the continuous plant. The flask is then transferred to the mold drying track, and after the blacking is applied, is permitted to pass slowly over the gas burners in the pit to dry the mold. At the end of this track, and after having passed over the gas burners, the flask is again moved onto a transfer car and is delivered to the first track from which it was suspended when the mold was rammed. After attaching the bottom plate, the core is set by a traveling crane, and the flask is again moved forward into position for receiving the metal. After casting, the core bar is pulled out, and after opening the flask, the casting is withdrawn by a crane, the shaking-out operation taking place directly over the sand preparing and tempering plant in the pit. The flask is then closed and is again moved forward to the molding machine, and the same cycle of operations is repeated without cooling the flask.

Continuous Pipe Foundry.

The general arrangement of the continuous pipe foundry, built by James B. Clow & Sons, at Coshocton, is illustrated in Fig. 2. It will be noted that the core department is an essential feature of this plant and it is so arranged, with

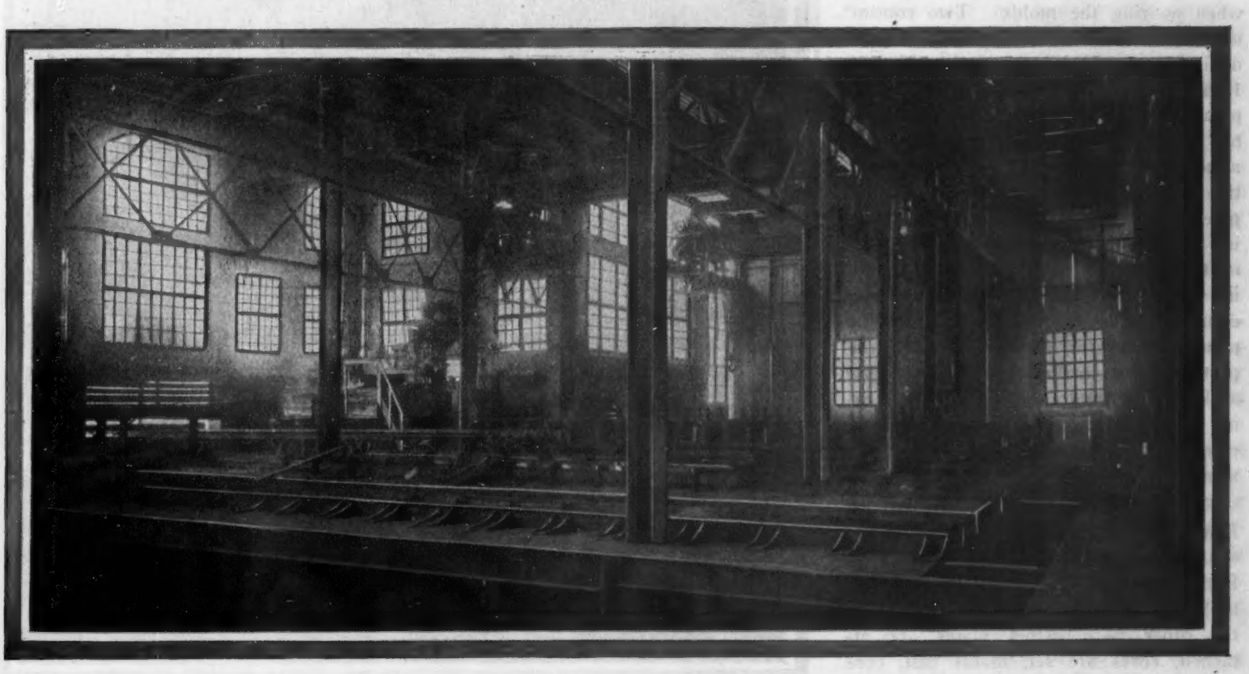


FIG. 4—GENERAL VIEW OF THE PIPE MOLDING AND CASTING PITS, SHOWING THE SAND PLATFORM OVER THE MOLDING MACHINE IN THE BACKGROUND.

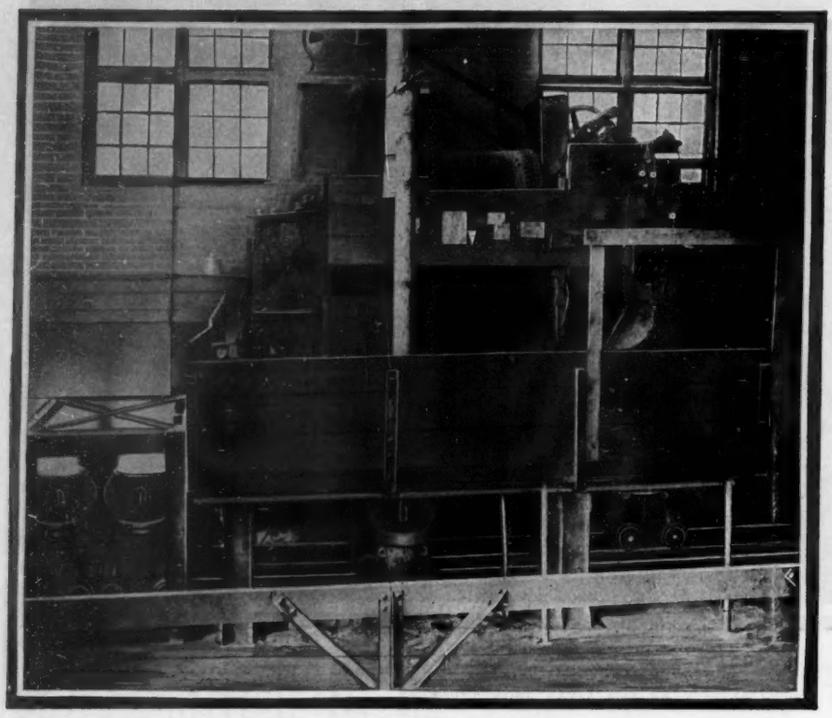


FIG. 5—SAND PLATFORM OVER THE MOLDING MACHINE, SHOWING TWO MEASURING TUBES, WITH THE TRANSFER CAR AT THE LEFT.

relation to pipe casting department, to effect a minimum of expense in the handling and setting of the cores. The building is 169 x 136 feet, with an offset at the molding machine end, 33 x 60 feet, and is 30 feet 4 inches high in the clear. Monitor ventilators, extending the full length of the building, are provided to carry off the smoke and gases, when pouring the molds. Two continuous units have been installed for producing 3, 4 and 6-inch, and 8, 10 and 12-inch water pipe, respectively. The plant for casting pipe of larger sizes has not yet been placed in operation, although it is practically a duplicate of the unit for manufacturing the smaller pipe, which will be described. Extending the width of the plant and underneath the offset, is a 12-foot basement in which are located the molding machines, sand tempering and preparing plant, burners for drying the molds, department for making and drying the socket cores, hydraulic ram for attaching the bottom plates, pump house, accumulator and other hydraulic equipment.

The flasks are vertically suspended from four tracks, supported by heavy structural steel members, as shown in Figs. 3 and 6. On two tracks the molds are blacked and dried, while on the other two bottom plates are attached, cores are set, molds cast, core bars pulled, castings shaken-out and the molds rammed, which is the first of the cycle of the continuous operations. The tracks are 20½-inch gage and extend a length of 72 feet. The flasks, as previously noted, are divided longitudinally into two sections and are supported on the tracks by four wheels. After shaking-out, the flasks are closed, the two halves merely being pushed together, and are held by eight cotter pins. The molds are rammed and poured, bell-end down, and the flasks travel in pairs for the various operations, such as molding, pulling the core bars and shaking-out the castings.

Cycle of Operations.

After the pair of flasks have been closed, they are moved over a section of track directly above the hydraulic molding machine, which carries two pipe patterns on pistons in independent cylinders. The tracks are lowered by a hydraulic ram permitting the flasks to be centered over the molding machines in the pit, as shown in the background, Fig. 15. Each flask is attached to the base of the molding machine by four cotter pins. After the flask has been centered and while it is being attached to the base of the machine, a measuring tube is lowered through the center of the flask. This tube, for 6-inch pipe, is 6½ inches in diameter and carries on its lower end a chilled cast iron cone which centers over the pattern, shown partly raised in Fig. 15. This cone is 7-3/16 inches in diameter, approximately 1/16 inch larger than the pattern, which is 7⅛ inches in diameter for 6-inch pipe. From the sand platform, located above the molding machine, Fig. 5, the sand is shoveled into the flask around the measuring tube, partly elevated out of the flask in this view, while in the background is a tube raised to its highest position, showing the cone attached to the end. The mold is then ready for

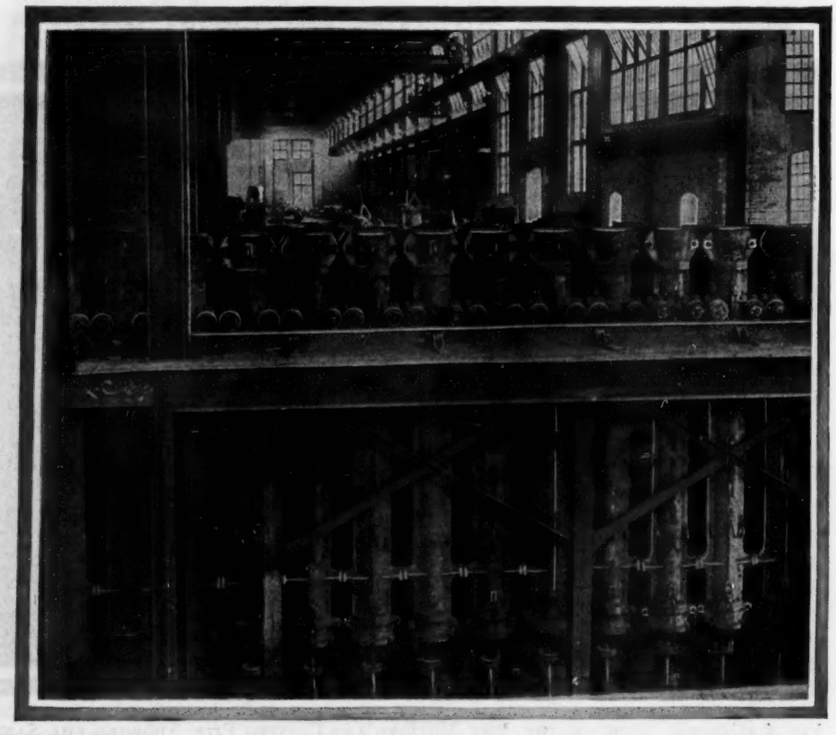


FIG. 6—A CLOSER VIEW OF THE DRYING TRACK, SHOWING THE GAS BURNERS UNDERNEATH THE MOLDS.

ramming, which is accomplished by the hydraulic piston carrying the pattern, forcing the chilled cast iron cone on the lower end of the measuring tube through the sand. Near the end of its stroke, the main pattern engages the socket pattern, lifting it, thereby molding the socket. The socket pattern is held in position by hydraulic rams, and at *A*, Fig. 12, it is shown in its normal position before it is engaged by the main pattern, while at *B*, it has been lifted and is in the position it assumes when molding the socket, or bell end of the pipe. The measuring tube, which is counterbalanced, is then elevated above the sand platform, and the spigot pattern, *C*, Fig. 24, is set on the end of the main pipe pattern, as shown at the right, Fig. 12. In addition to the spigot, this pattern forms the four gates and the pouring basin. The main pattern is then lowered and the spigot pattern drops by gravity into the upper end of the flask, forming the basin, gates and guides for the core in one operation. The main pattern is again raised, carrying the spigot pattern about 2 inches above the mold, as shown at *D*, Fig. 12, and at *C*, the spigot pattern is shown suspended before it is set on top of the main pattern for lowering into the mold. The main pattern is then withdrawn and the socket pattern is lowered by the hydraulic rams which have held it in position, thus completing the mold. The approximate time required for making a complete mold is approximately 2½ minutes.

FIG. 8—SHAKING-OUT THE PIPE BY AN ELECTRIC TRAVELING CRANE.

FIG. 7—SETTING THE MAIN PIPE CORES BY AN ELECTRIC TRAVELING CRANE. ONE OF THE TWO TRANSFER CARS IS ALSO SHOWN.

Ramming the Sand.

The cone of the measuring tube, which is forced through the sand ahead of the main pattern, thus ramming the mold, is 1/16 inch larger than the pattern. It has been found that there is a sufficient elasticity in the sand to compensate for this difference in diameter and the molds are all true to the size of the pattern. In lowering the pattern through the mold it has a sleeking effect on the sand, which is subsequently reflected by the smooth surface of the castings. For making pipe of smaller diameter, no additional flask equipment is required and the only changes necessary are measuring tubes and patterns of a smaller diameter. This permits of molding 3, 4 and 6-inch pipe in the same flasks and greatly reduces the expense of this equipment. The density of the mold can also be regulated as desired, by either increasing or decreasing the diameter of the measuring tube. If it is deemed advisable to ram the molds harder than usual, the diameter of the measuring tube is slightly decreased, thus permitting the use of a greater quantity of sand. On the other hand, the molds can be rammed soft by increasing the diameter of the tube, thereby reducing the amount of sand filled into the flask. This method of ramming can be almost considered the ideal for which foundrymen have been striving, as the mold is rammed uniformly hard next to the pattern, decreasing in density to the side of the flask, thus venting freely.

A sectional view of the pipe molding machine is shown in Fig. 12. It consists of two hydraulic cylinders, having

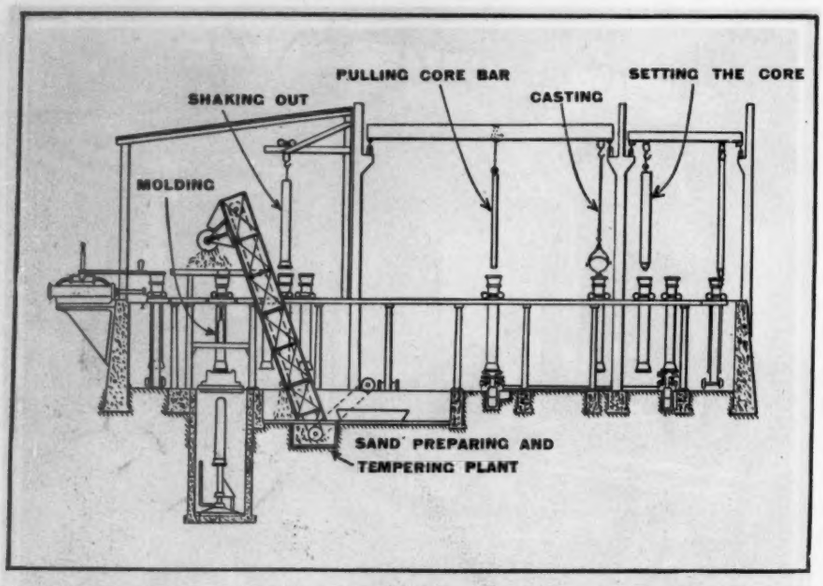


FIG. 9—DIAGRAMMATIC VIEW OF A PIPE MOLDING AND CASTING PLANT, SHOWING THE CYCLE OF ALL OF THE OPERATIONS.

pistons about 10 feet long, operated independently of each other. Each piston carries a pipe pattern which is fixed vertically into the piston, the pattern being the full length and diameter of the pipe to be molded. The socket or bell pattern is located at the lower end of the pipe pattern and is made to move up and down in a casing accurately machined concentric with the pipe pattern. The cylinders are 10 inches in diameter and are encased in a pit, 24 feet 9 inches deep and 7 feet 5 inches outside diameter. A side elevation of the arrangement of the molding machine and runway is shown in Fig. 23.

After the removal of the cotter pins by which the flask was attached to the base of the molding machine, the track with the suspended mold is again raised to the level of the runway and is moved along onto the track of the transfer car, shown at the left, Fig. 5, which has a capacity of four molds. This car, with its finished molds, is then transferred by a hydraulic pusher to the runway, carrying the two mold drying tracks. Another hydraulic ram pushes the molds from the transfer car, and these molds in turn move all of the flasks on the two drying tracks. In this way the molds are steadily carried forward, not only on these tracks, but on the other runway, where the coreing, casting and shaking-out is done. After blacking, the molds pass over a series of open gas burners, arranged in two rows, one under each track. The outside row of burners is clearly shown in Figs. 3 and 6, which also illustrate the vertical suspension of the flasks from the drying track into the pit. With the burners underneath the molds, every opportunity is afforded for close inspection and examination, and imperfect molds are marked to prevent the setting of cores and casting, thereby effecting a considerable reduction in the losses from defective castings. The two rows of burners extend the entire length of the runway and a mold remains about one hour and 40 minutes on the drying track. This period has been found ample to sufficiently dry the molds for casting.

At the opposite end of the runway, Fig. 7, the molds are again moved onto a transfer car and are conveyed to the other two tracks for coreing, casting, shaking-out, etc. The bottom plates are attached in the pit, being elevated into position underneath the molds by hydraulic hoists. A bottom plate with a sand head in position, which forms the socket of the pipe, as well as the centering socket for the main or body core, is shown at *A*, Fig. 24. A part section of a mold, after casting, is illustrated at *A*, Fig. 13, *D* being the core, *E* the casting, *G* the socket core and *F* the metal cone socket, into which is received the cone-shaped end of the body core, thereby forming a centering support for the core at the bottom of the mold. A part side elevation and longitudinal section of a flask showing the relation of the mold, core and head in assembled position, with the pipe section cast therein, is shown in Fig. 11; *A* and *B* are detail views in transverse section on the lines *CC* and *DD*, Fig. 11, respectively; *B*, Fig. 13, is a transverse section of the bell end of the mold, showing the bottom plate, socket core and cone for centering the core.

After attaching the bottom plates, the

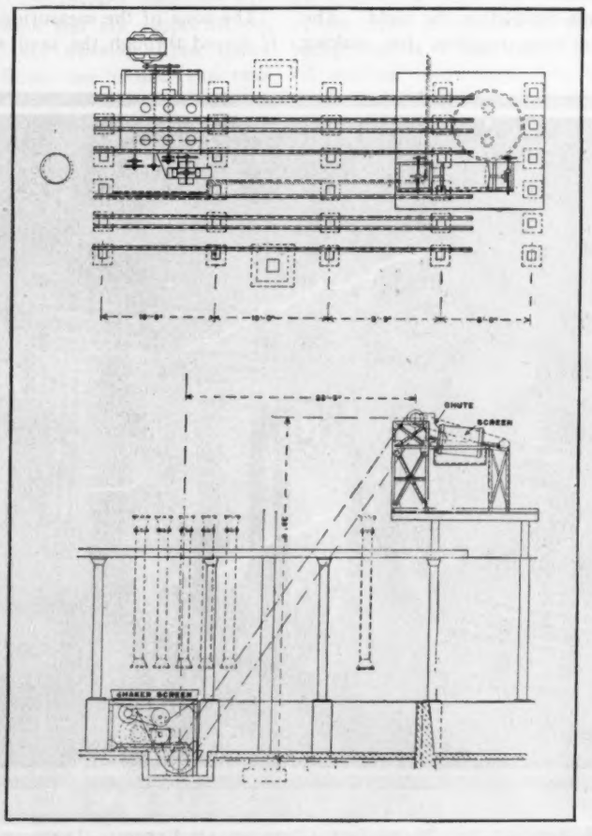


FIG. 10—GROUND PLAN AND SIDE ELEVATION OF THE SAND-PREPARING, TEMPERING AND HANDLING PLANT.

molds are pushed off the transfer car onto the casting tracks by hydraulic rams, and the main body cores are lowered into position by an electric traveling crane, as illustrated in Fig. 7. This core is self-centering, being cone-shaped at its lower end, and is received into a cone-shaped socket on the bottom plate, while a collar, turned onto the core about 6 inches from its upper end, not only centers the core at the spigot end of the mold, but also completes the

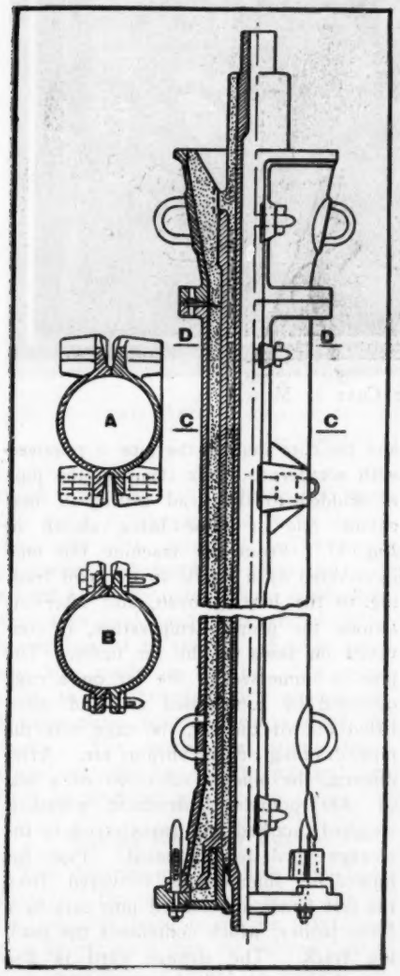


FIG. 11—SIDE ELEVATION AND LONGITUDINAL SECTION OF A PIPE FLASK CONTAINING A CASTING

gates and the pouring basin. As additional molds are transferred to the casting tracks, those already cored are gradually moved forward to the point where they are poured.

Pouring and Shaking-Out.

At present, the metal is cast from a geared ladle, suspended from an electric traveling crane, Fig. 1, but a 3-ton wall crane is being installed for this purpose, which will also carry the metal from the cupolas to the pipe casting pits. After casting, the flasks are again

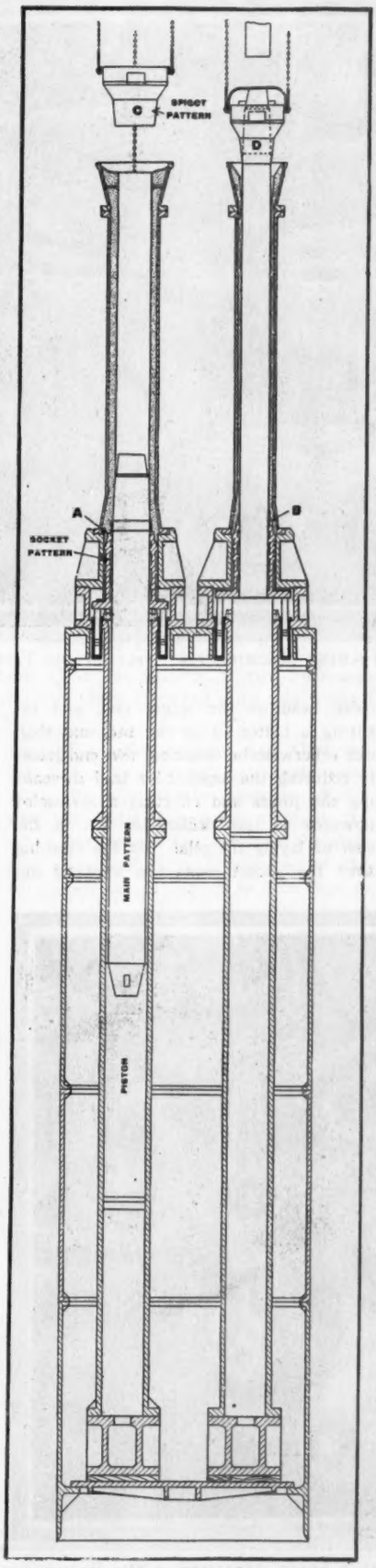


FIG. 12—SECTIONAL VIEW OF THE MOLDING MACHINE, SHOWING THE HYDRAULIC CYLINDERS AND PATTERNS.

moved forward on the tracks and the core bars are pulled from two flasks at a time, by an electric traveling crane, which deposits them on a car on which they are returned to the core department. The cotter pins holding the halves of the flasks together are then knocked out and the flasks are opened to permit of the removal of the castings. Two chains, hooked onto a bail suspended from the crane, are lowered through the castings, automatically gripping the pipe at the bottom. The castings are shaken-out, as illustrated in Fig. 8, are lowered onto a skid, 16 feet 4½ inches wide, at the side of the run-

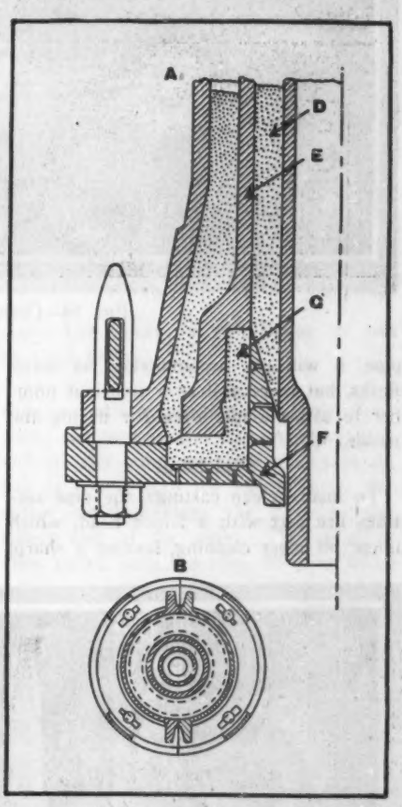


FIG. 13—PART SECTION OF THE BOTTOM OF THE FLASK, SHOWING THE BOTTOM PLATE, SOCKET CORE, ETC.

way, and are rolled out of the building into the cleaning shed. The flasks are again closed and without permitting them to cool, are slowly moved forward onto the machine section of the runway for another cycle of operations. In Fig. 2, the sequence of the various operations is clearly indicated. The pit for 3 to 6-inch pipe is equipped with 120 single flasks, equal to 60 double flasks in the parlance of the pipe founder, and to complete the cycle, approximately two hours are required. This pit has a capacity of 600 pipes in 20 hours, and it is the intention to operate 20 hours per day, divided into two shifts. As the runway of the pit for large pipe is of the same length as the one for small

FIG. 14—CORE-FORMING MACHINE FOR APPLYING THE FIRST COAT OF MUD.

pipe, it will not accommodate as many flasks, but there will be a sufficient number to allow ample time for drying the molds.

Finishing.

To insure clean castings, the pipe sections are cast with a 5-inch head, which is cut off after cleaning, leaving a sharp, clean bead on the spigot end, and insuring a better fit in the bell end than can otherwise be obtained, thereby greatly reducing the amount of lead in making the joints and effecting a saving of upwards of one dollar per ton in the cost of laying the pipe. In the cleaning shed the socket irons are knocked out and the core sand in the pipe is removed with scrapers. After cleaning, the pipe is skidded to the head cutting-off machines, one of these being shown in Fig. 17. From the machine the pipe is elevated by a cradle to the skid leading to the heating oven, and after attaining the proper temperature, is conveyed on skids to the tar tanks. The pipe is immersed in the tar on a cage operated by compressed air, and when lifted out of the tar, the cage tilts the pipe, draining off the surplus tar. After dipping, the pipe is subjected to a test of 300 pounds hydrostatic pressure, weighed, marked and transferred to the storage yard for shipment. Pipe for immediate shipment is conveyed from the test house and loaded into cars by a 5-ton trolley, which commands the loading track. The storage yard is also served by a 5-ton bridge crane, 110 feet span and 400 feet long, installed by the Cleveland Crane & Car Co., Cleveland.

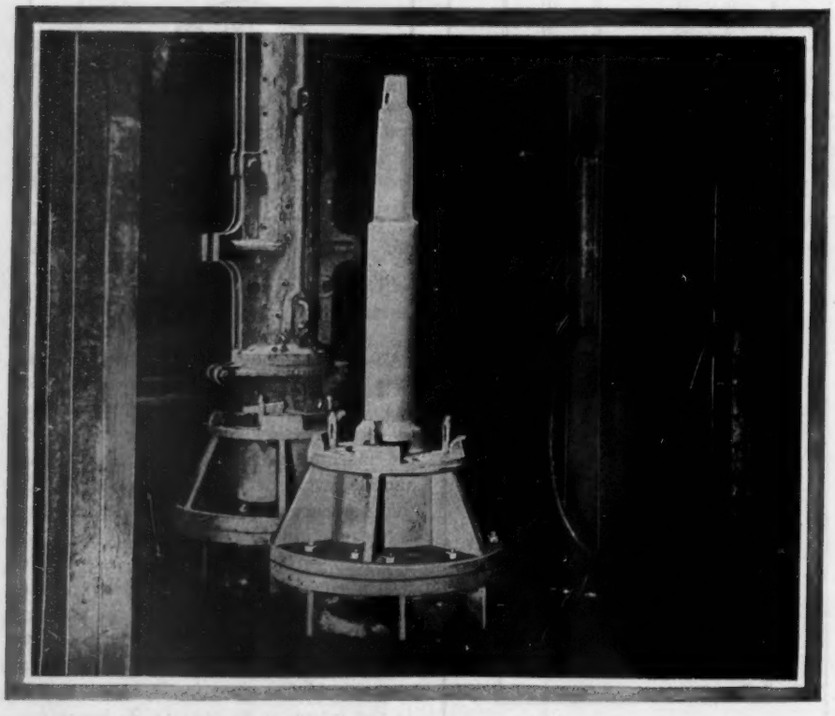


FIG. 15—THE MOLDING MACHINE, SHOWING A FLASK ATTACHED IN THE BACKGROUND, AND THE MACHINE WITH THE PATTERN PARTLY RAISED BEFORE THE FLASK IS LOWERED, IN THE FOREGROUND.

Sand Preparing Plant.

The sand tempering and preparing plant, plan and side elevation of which are shown in Fig. 10, is located directly below the shaking-out section of the runway. Here the hot sand is tempered, mixed with new sand, riddled and delivered in buckets on a conveyor to a chute above the sand platform, Fig. 5, from which it falls into a rotary screen and is dropped onto the sand platform. No difficulties have been experienced from the use of this warm sand, in fact, it is considered an advantage, as it facilitates the drying of the

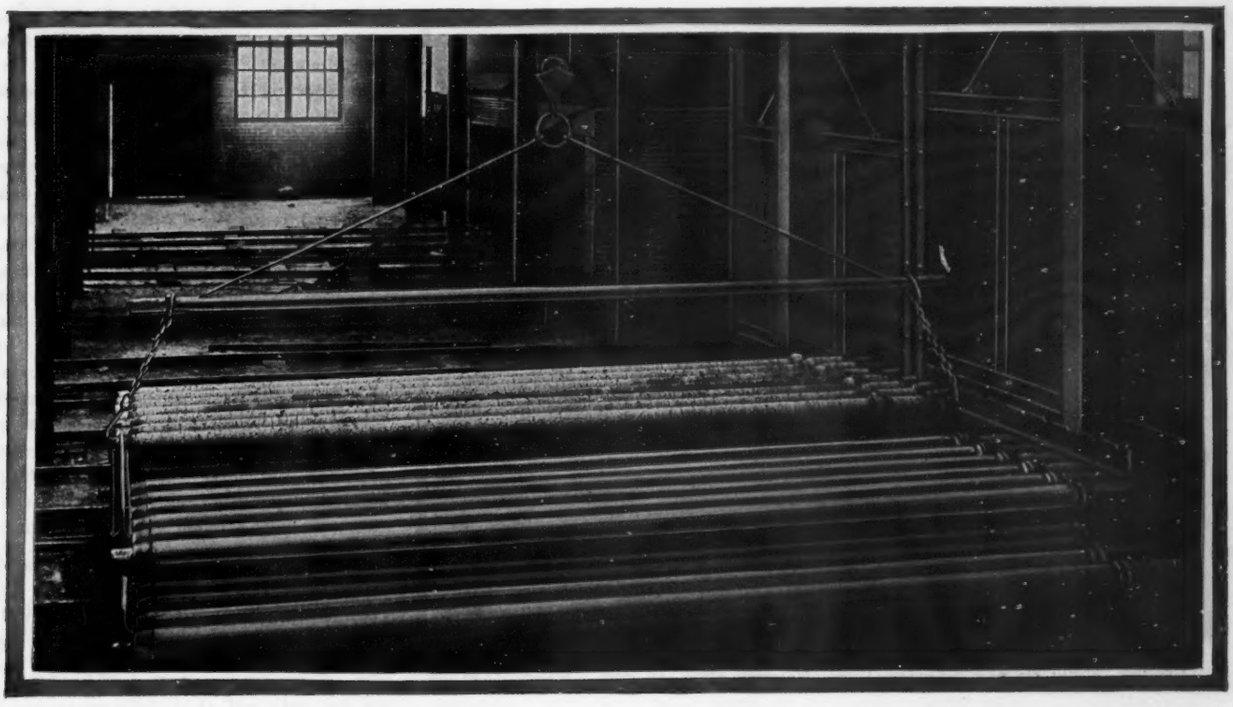


FIG. 16—CORES AFTER RECEIVING THE SECOND COAT ARE SHOWN IN THE FOREGROUND, AND THE CORES ON THE BUGGY IN THE BACKGROUND HAVE JUST BEEN RECEIVED FROM THE FIRST COAT CORE OVEN.

mold. The flask, also, being hot when the mold is rammed, to some extent also aids this operation. The sand-preparing and handling plant was installed by the Standard Sand & Machine Co., Cleveland, and is operated by a motor located in the pit. Socket cores are also made in the pit at a point close to the hoists, which elevate the bottom plates to the lower end of the flasks. The ovens for drying these cores are likewise in the pit and are fired by producer gas.

Making the Body Cores.

The department in which the body cores for the pipe are made, is one of the essential features of the plant, and it is so arranged that the various operations follow each other in natural sequence, steadily carrying the cores forward until they are delivered to the pipe shop. A plan view of the core department, showing the arrangement of the first and second coat drying ovens, the core-forming machines and the grinding pans, is illustrated in Fig. 2. After the core bars are pulled, they are deposited on a car, operating on a track leading from the pipe foundry to the opposite end of the core shop, where the first coat of core sand is applied. The bars, which are still hot, are picked up by a trolley and are conveyed to the core forming machine for receiving the first coat. The method of handling the core bars is shown in Fig. 14. The first coat of mud has been applied to one bar still on the machine, and after the bar has been lowered onto extensions from the tops of the supports of the core bar while it is being revolved, the other bar, which has received the first coat, is picked up and delivered to the core oven car. The other core bar is then moved into position and is revolved while turning on the hay. At the spigot end of the core an extra thickness of hay is rolled onto the bar to form the collar which centers the core in the spigot end of the mold. The mud is then rolled onto the hay, the core lifted

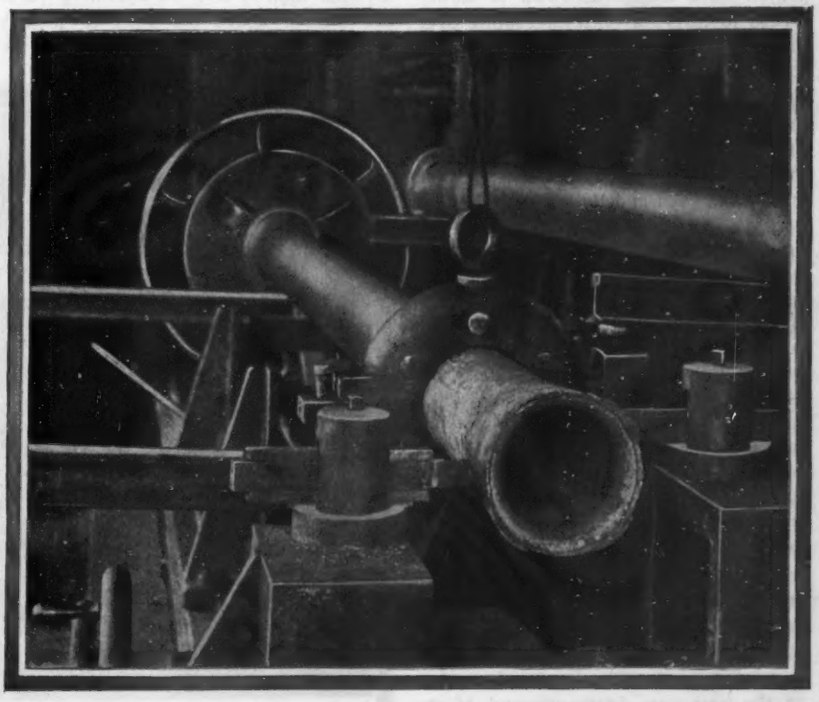


FIG. 17—ONE OF THE MACHINES FOR CUTTING-OFF THE HEADS FROM THE SPIGOT ENDS OF PIPE.

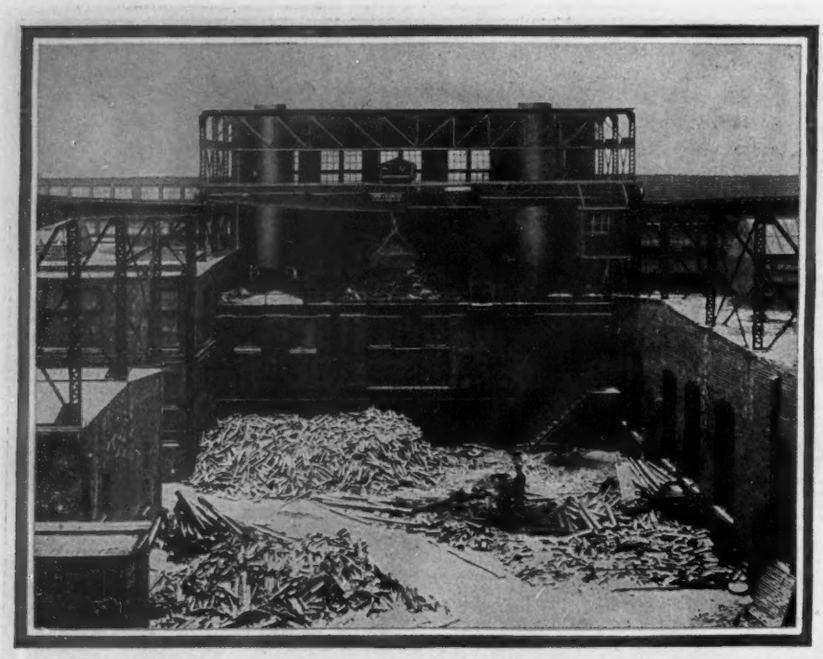


FIG. 18—VIEW OF THE STORAGE YARD, LOOKING TOWARD THE CHARGING FLOOR.

off and placed on the core oven car, shown on the second track, Fig. 16, which is a view of the cores after the first coat has been dried. The cores are delivered to the other core-forming machine by an overhead trolley, where they receive the second, or finishing coat of mud. The core bar is revolved as when applying the first coat, and after the mud has been rolled on, blacking is poured onto the core, which is slowly turned to insure a uniform coating over the entire surface. The cores are again loaded onto a core oven car, shown in the foreground, Fig. 16, and are run into the second battery of ovens for drying. After the cores have been dried, the car is moved out of the forward end of the oven and the cores are picked up by a crane, as required, and are set in the molds. The crane, which serves the core-setting section, has a span of 10 feet, is of 3 tons' capacity, and travels the entire width of the shop.

Core Oven Equipment.

Each pipe-making unit is served by two batteries of three ovens, the first for drying the first coat and the second for drying the finishing coat. Twelve tracks for the core cars are laid through the core shop to the pipe foundry, two tracks passing through each of the first and second coat ovens. Both ends of the ovens, which are 13 x 16 feet 6 inches each, are closed by rolling doors to permit of the uninterrupted passage of the core cars from one end of the shop to the other and through the entire cycle of operations without transferring the car from one track to another. As the core bars are still hot when the first coat of mud is rolled on, the drying operation is facilitated and the cores remain only 30 minutes in each oven for drying the first and second coats, respectively. At one end of the shop are located two large grinding pans, Figs. 2 and 21, which grind the clay and sand, of which the core mud is made. These pans are driven by individual motors and all operating parts are located above the rolls to protect them from the sand. Adjacent to the grinding pans are sand and clay bins, which hold a sufficient stock for a day's operations.

In addition to the continuous system of making pipe, another economy introduced consists of the utilization of the tar from the producer gas plant for coating the pipe. A sufficient amount is recovered from these producers to meet the requirements of the works. Producer gas is not only used for operating the engines, but serves as the fuel for drying the molds and cores, heating the tar tanks, pipe heating ovens, etc. In the ovens for drying the pipe cores, rows of open flame burners are located between the tracks, and despite the proximity of the burners to the lower tier of cores, the latter are dried uniformly throughout.

The Clow Plant.

The Clow plant is admirably located on a site of 70 acres, just beyond the confines of the city of Coshocton. With the exception of the office, all of the buildings are located in a valley, and the natural unloading advantages afforded by a hill overlooking the works were utilized to the fullest extent. To reduce the cost of handling raw materials to the minimum, the receiving tracks were laid on the hill, and coke, coal, limestone, etc., is delivered by gravity to the ground level of the plant. Coke and limestone are dumped from drop-bottom cars into concrete bins, while the coal for the producer plant is similarly unloaded. As originally arranged, the pig iron was to have been unloaded from cars on the hill overlooking the plant, and after making up the charges,

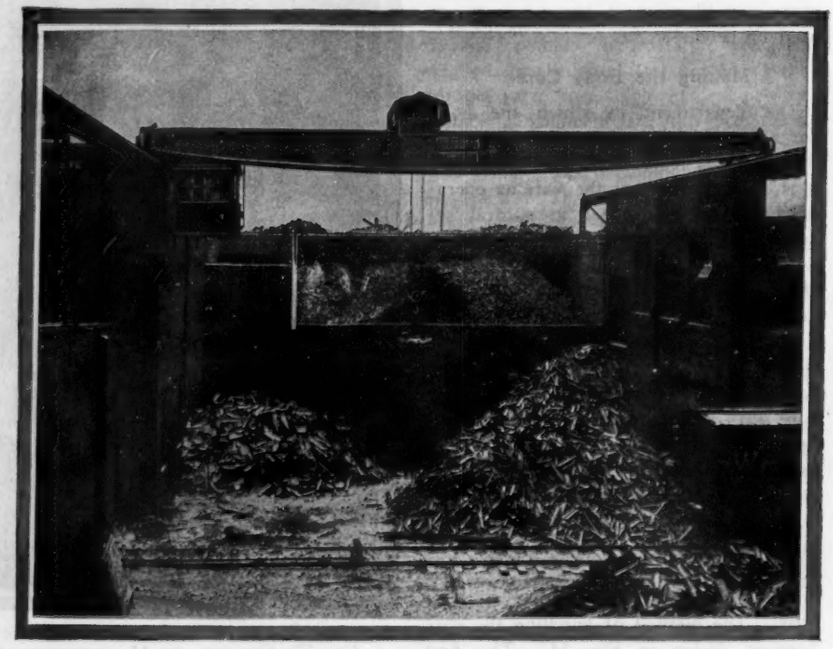


FIG. 19—VIEW OF THE STORAGE YARD, LOOKING TOWARD THE COKE AND LIMESTONE BINS, SHOWING THE RECEIVING TRACK ON THE UPPER LEVEL.

the iron was to have been delivered to the storage yard crane to be conveyed to the charging floor. This method of handling the pig metal will be adopted later, and the upper yard will be served by a crane. At present, pig iron and scrap are received over a track extending between the pattern storage and the gray iron foundry, as shown in the ground plan of the plant, Fig. 22, and is unloaded from the cars and is delivered to the charging floor by a lifting magnet.

FIG. 21—THE SAND AND CLAY GRINDING PANS.

Special Gray Iron Foundry.

In addition to the continuous cast iron pipe shop, a large gray iron foundry is operated for the production of a wide variety of castings, including cast iron water pipe fittings, drinking fountains, watering troughs, ornamental columns, etc. This foundry is located between the pipe plant and the machine shop. The building is of brick and steel construction, 152 x 201 feet, and is divided into four bays, 25 feet 6 inches, 38 feet 3 inches, 38 feet 3 inches, and 50 feet wide, respectively. In the first bay are located two batteries of core ovens, two in each battery, 6 x 15 feet, and 7 feet 8 inches high. Another large core oven is located in the other side bay, 12 x 18 feet, and 10 feet high. These ovens are all fired by producer gas, with the open flame type of burners.

Heavy work is molded in the two middle bays, while in the side bays the lighter castings are made. The molding machine equipment consists of a pneumatic jar-ramming machine, stripping plate machines, as well as a number of squeezers. One of the two middle bays is practically an extension of the center bay of the machine shop and is commanded by a 10-ton crane, which serves both departments. Two 5-ton electric traveling cranes command the other middle bay and one of the side bays of the foundry. An industrial track in the foundry is used for conveying water pipe fittings to the tar dipping tank outside of the shop. The cupola shown at the right, Fig. 20, has two spouts, the one extending into the gray iron foundry. The shop is well lighted and ventilated, a monitor extending the entire length of the building, and there are two skylights in the roof over the two side bays, each 40 x 13 feet, while the skylight over the cleaning room is 20 x 13 feet. For facing the molds, cement is successfully used in this foundry, for both light and heavy work.

FIG. 20—THE TWO CUPOLAS, SHOWING THE MEZZANINE FLOOR IN THE BACKGROUND.

Cupolas.

The cupolas are located between the gray iron foundry and the pipe shop, as illustrated in Fig. 20. Thus far only two furnaces have been installed, although two additional cupolas will be added, to provide sufficient metal for the pipe foundry. The large cupola at the left is 108 inches in diameter and is lined to 84 inches, while the small furnace is 84 inches in diameter and is lined to 66 inches. The two cupolas to be installed will be 108 inches in diameter, all of the furnaces being of the Whiting type, built by the Whiting Foundry Equipment Co., Harvey, Ill. The blowers are located on a mezzanine floor below the charging platform, and are of the positive pressure type, furnished by the B. F. Sturtevant Co., Hyde Park, Mass. The charging floor, Fig. 18, is 55 x 28 feet, and is served by the storage yard crane. The cupolas are operated continuously, the first iron coming down at about 6 o'clock in the morning and the blast is not shut off until 4:30 p. m. No difficulties have been experienced from the continuous operation of the furnaces, as they are of sufficient diameter to obviate the difficulties

so frequently experienced when operating small cupolas continuously. While ample coke is used, the average melting ratio is 1 to 10, but this would be smaller but for the fact that the coke bed is spread over an unusually large tonnage. The use of cast iron brick, cored out in the center, for lining the cupola opposite and slightly below the charging doors has effected great economies in the cost of lining repairs. Opposite the charging door, the lining of a cupola is generally worn away rapidly from contact with the pig iron when thrown into the furnace. The cast iron brick withstands this severe usage and frequently no repairs need be made to this section of the stack in four or five years. The bricks are not melted, as they are located sufficiently high above the melting zone to obviate this. The cast iron bricks are 7 x 3 x 2½ inches, and are laid in fire clay. When charging the borings received from the machine shop, they are placed in discarded nail kegs and tar is poured over them to bind them together. This method of utilizing this scrap has resulted in exceedingly low melting losses, and the tar provides the cupola with excellent fuel.

Storage Yard.

The storage yard is 200 x 55 feet, and is located between the cupolas and the concrete coke and limestone bins, as shown in Figs. 18 and 19. The yard is commanded by a 5-ton electric traveling crane, installed by the Case Crane Co., Columbus, O. The pig iron and scrap is unloaded from cars by an electric magnet which also delivers this material to the charging floor. Coke and limestone is loaded directly into charging boxes from the coke and limestone bins, Fig. 19. The lifting magnet was furnished by the Electric Controller & Mfg. Co., Cleveland.

Machine Shop.

The machine shop, Fig. 22, is 161 x 89 feet, and is divided into three bays. The middle bay is 38 feet 3 inches, and is served by a 10-ton electric traveling crane, which also commands the gray iron foundry and the section of the shop in front of the cupolas. A standard gage track leads into the shop to facilitate the loading of the finished product from the gray iron foundry. The building is of brick and steel construction, and ample light and ventilation is provided by two lantern monitors, 20 feet long and 13 feet wide, and side lights extending the length of the building. All of the windows are operated by the Pond sash operating device, installed by David Lupton's Sons Co., Philadelphia. The machine tool equipment of the shop is unusually complete and of sufficient capacity to finish the largest castings made in the gray iron foundry.

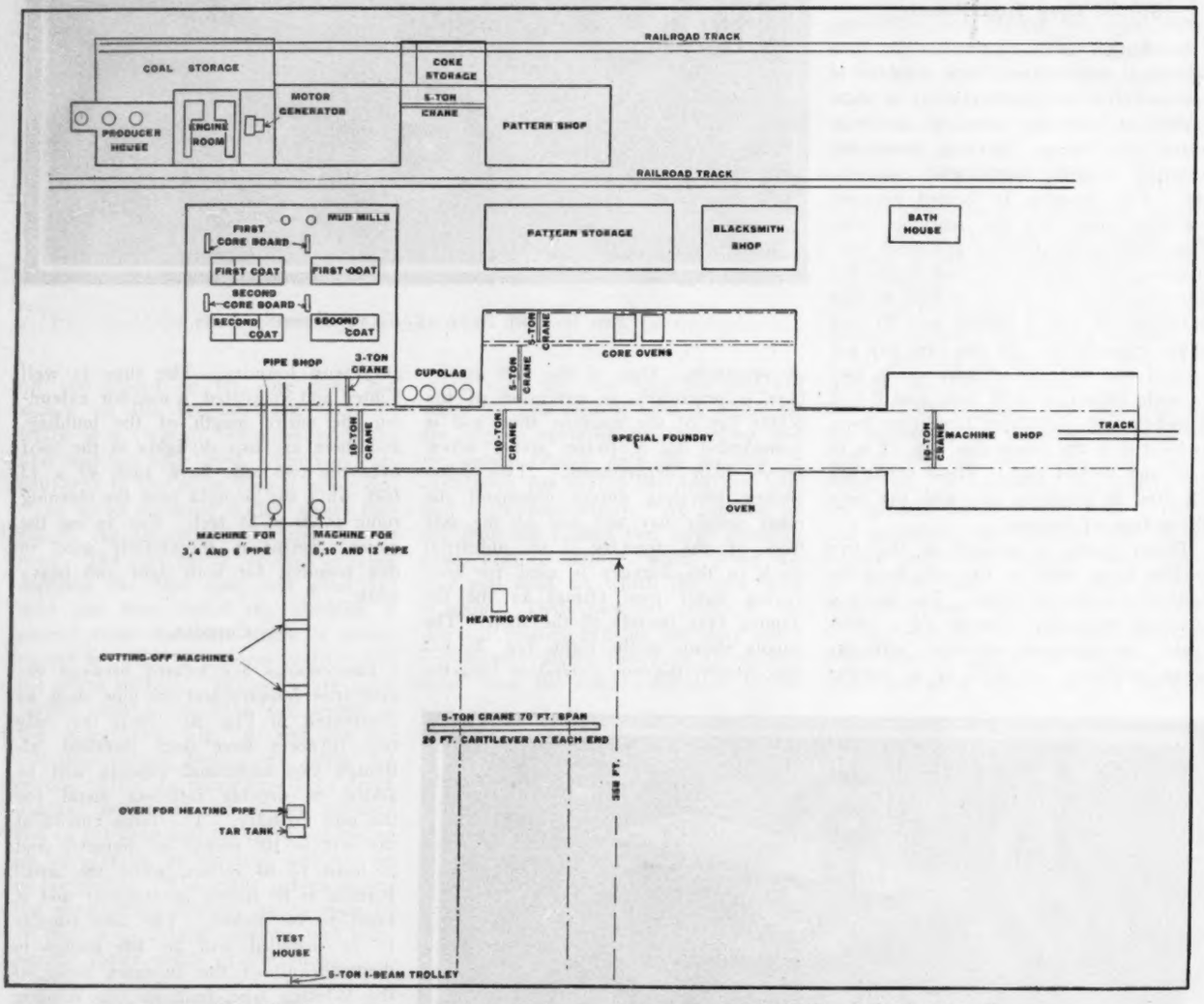


FIG. 22—GROUND PLAN OF THE PLANT OF JAMES B. CLOW & SONS, COSHOCTON, O.

Power Plant.

The power plant is of reinforced concrete and brick construction, with steel roof trusses. The engine room is 65 x 45 feet and 20 feet high. The equipment consists of two 250-horsepower gas engines, installed by the Riverside Engine Co., Oil City, Pa., direct-connected to 100-kilowatt Westinghouse generators.

Air compressors are attached to the end of each engine and the entire power plant is commanded by a 5-ton electric traveling crane. On the basement level of this building will be located an auxiliary power plant, consisting of a 200-horsepower motor generator set, which will be furnished with alternating current from the local lighting plant.

The producer house is 48 x 35 feet with an extension, 15 x 17 feet. It is equipped with three gas producers of 750 horsepower capacity each, installed by the Holbeck Co., Cleveland The tar recovered as a by-product from this plant is used for coating the cast iron pipe. The coal for the producer plant is unloaded from the cars and is delivered by gravity to the producer house platform.

Miscellaneous Departments.

Adjoining the power plant is the hay storage building, 80 x 50 feet, two stories high and of reinforced concrete and brick construction. The bales of hay are unloaded from cars on the receiving track on the hill overlooking the plant into chutes leading into the second floor of the hay storage building. On the lower floor are located the hay rope winding machines and the bales of hay, as required, are dropped through an opening in the storage floor to the ground floor level.

The pattern shop is 80 x 50 feet, of brick construction with the exception of the brick wall built into the hill, which is of reinforced concrete construction. The pattern lumber is unloaded from the cars and is delivered to the shop through two chutes leading into the side of the building. The pattern storage is 121 x 41 feet, of brick construction, 16 feet 6 inches high. One end of the building, 20 x 41 feet, is partitioned off for the flask and pattern repair department. The remaining buildings include a blacksmith shop, 61 x 41 feet, and a bath house, 46 x 63 feet, equipped with shower baths and other conveniences for the men.

The entire tract of land on which the works are built is underlaid with molding sand and clay, and all of the sand used in the gray iron foundry and the pipe shop is mined on the property. Side tracks from the Wheeling & Lake Erie and Pennsylvania railroads afford good facilities for the receipt of raw and the shipment of finished materials.

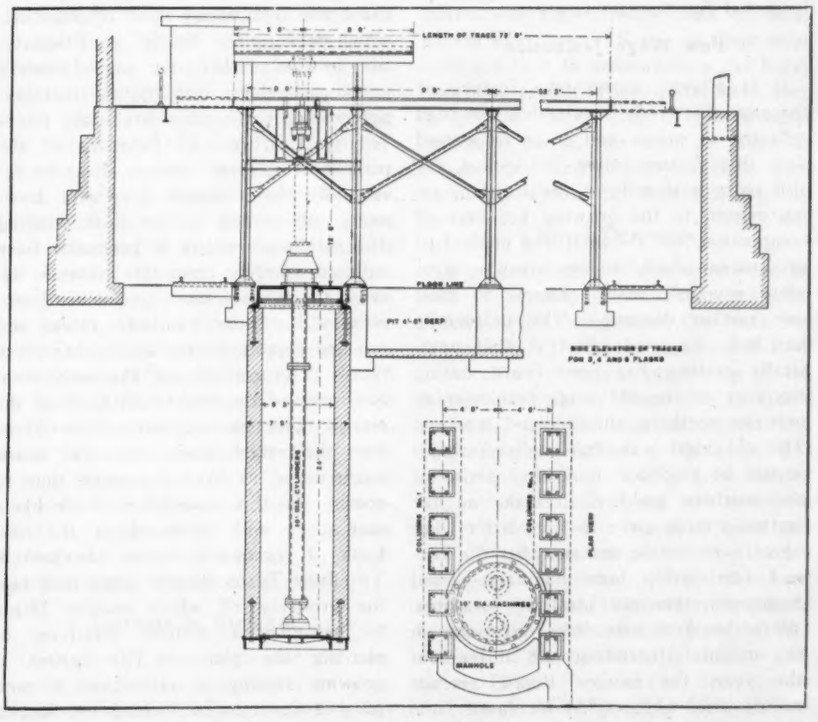


FIG. 23—SIDE ELEVATION OF PIPE MOLDING MACHINE AND SECTION OF RUNWAY.

Henry E. Pridmore

A settlement of the estate of the late Henry E. Pridmore, Chicago, was recently effected and the molding machine business conducted under his name is now owned and will be carried on by Mrs. E. M. Pridmore and son, H. A. Pridmore. The firm name, Henry E. Pridmore, will be retained, and there will be no change in the conduct of the affairs of the concern. The mechanical and sales organizations will remain practically unchanged, and R. E. Turnbull, who has been associated with Henry E. Pridmore for many years, will, in adddition to his new duties, continue to represent the firm in the central west. D. F. Eagan, whose headquarters are in Boston, will continue to represent Henry E. Pridmore in the New England states and eastern New York. Wm. H. Phinney, whose headquarters are in Philadelphia, will continue to represent the firm in eastern Pennsylvania and throughout the southern states. A. V. Magnuson, who will be the plant superintendent, was associated with Henry E. Pridmore since the establishment of the business and has been a prominent factor in the development of the Pridmore labor-saving molding appliances.

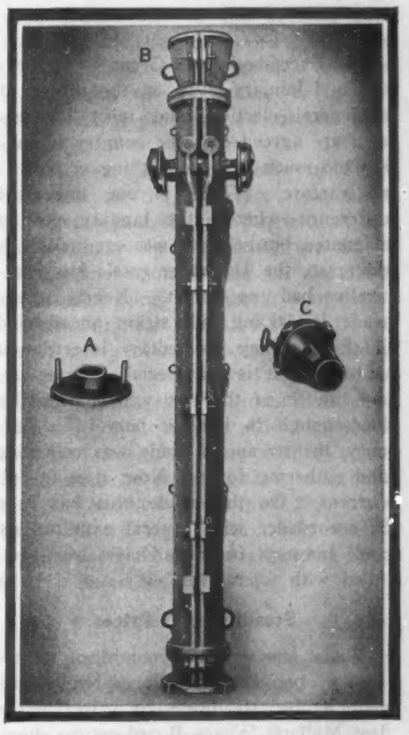


FIG. 24—BOTTOM PLATE, FLASK AND SPIGOT PATTERN.

Shot in Cast Iron

Thos. D. West, 10511 Pasadena avenue, Cleveland, who is soliciting specimen castings containing globules in gas cavities, solidly encased shot iron, hard streaks or spots and white iron inside of gray or soft iron, announces that he will receive such specimens to March 1, instead of Jan. 1, as at first intended. A paper on this subject will then be prepared for presentation at the Pittsburg meeting of the American Foundrymen's Association. Mr. West is desirous of securing all the specimens he possibly can and the firms or individuals forwarding castings exhibiting these phenomena will not necessarily have their names mentioned in the paper unless desired.

Great Britain Suffers from too Much Politics

But the Year Ends With a Hopeful Prospect—Governmental Intervention in Wage Disputes—Prosperity of Tin Plate Makers

By J. Horton.

Mid-December finds Great Britain, as did mid-January, 1910, in the throes of a general election, and most business men are agreed that the country is having too much of a good thing in political warfare. There is one important difference—whereas the January election stagnated business, or was credited with doing so, the December tussle has practically had no effect. Nearly every trade is driving full steam ahead, and if there is any momentary interruption of orders, it is immaterial, because every branch of the iron and steel trades has enough to keep it busy. In January, the stream of trade was collecting and gathering force. Now, it is in full current. On the whole, this has been in accordance with general expectations, and January forecasts have been fulfilled with tolerable fidelity.

Steadiness of Prices.

But a glance at the record of figures shows one remarkable circumstance, namely, the steadiness of prices. The last Midland Wages Board return shows a selling figure for September and October of £6 7s 2d. At the beginning of 1909, the average was £6 5s 4d, or within 1s 10d of the present figure, and puddlers' wages remained throughout the year at 8s 6d per ton, as they did also throughout the previous year. This would be a record difficult to match in the history of the iron trade. The official figures of selling prices show that for the first two months, the net average was £6 3s 10d, for March and April £6 5s 9d, May and June £6 6s 11d, July and August £6 6s 2d, and September and October £6 7s 2d. It seems unlikely that the remaining two months, the report of which will come towards the end of January, will show any material change. Fluctuations are more noticeable in regard to detail—angles and tees, for example, commencing the year at £6 8s, reaching £6 17s in July and receding to £6 13s 3d in September and October. The tonnage return shows a relatively large output by the 17 selected firms who govern wages, for the whole of the year, varying from 33,837 tons in May and June to 38,687 tons in September and October, decidedly the heaviest output of any bi-monthly period. The same uniformity has by no means been maintained in the north of England, the fluctuations in price giving the northern workmen an advance of 2½ per cent from Jan. 31, which they were called upon to relinquish two months later. Again, in September they obtained 2½ per cent, and lost it again at the end of November. The northern workmen have been rather lucky in just realizing the requisite amount to carry advances, but even there the fluctuations have not been extreme. The prices in the north were as follows: January and February £6 7s 4d, March and April £6 6s 6d, May and June £6 7s 5d, July and August £6 8s 9d, September and October £6 5s 10d. A curious feature of this last bi-monthly period is that while the reduction was one of the largest, amounting to 2s 11d per ton, the output in the north was greater than in any bi-monthly period for the last two years.

Few Wage Jealousies.

It is a very conspicuous feature of the year that trade activity has not been reflected in prices and it is recognized that this feature must be looked for still more uniformly in the future, having regard to the growing keenness of competition, and the improved method of production which enables manufacturers more promptly than formerly to meet any sudden demand. The uniformity has had one good effect in that practically nothing has been heard during the year of the old wage jealousies as between northern and midland workers. The old ideal was that midland wages should be sixpence more than those of the northern puddler, to make up for certain extras paid to the latter; but never once during the year has the correct relationship been maintained, and apparently this old ideal is forgotten. While marked bars have remained in the midland district at £8 throughout the year, the Wages Board average selling price of bars has increased from £6 4s 1d to £6 7s 6d, a rise which must be credited to common unmarked iron. That is the sole achievement by bar makers in their tremendous struggle to secure profitable prices. Unmarked bar making throughout the year has been practically unprofitable, the only improvement experienced by manufacturers being a little relief in that, owing to slightly heavier output, they are a little better off in the matter of the proportion of dead charges.

Production Increases.

Coming now to details in finished iron, a steady improvement has to be recorded in output. The mills are all busier, and in this respect have steadily improved through the year. The lead has been taken by galvanized sheets, which have done a splendid business, although the selling price is not quite so good as it was in January, when some dealers were able to secure £12, the standard price being £11 10s. Sheets can now be bought at £11 2s 6d, a change partly brought about by the opening of a number of Welsh mills, combined with the entire absence of any sort of agreement as to prices. Sheet makers generally have frequently lamented the collapse of their combination, which took place finally in February. Six months earlier, the manufacturers announced their inability to maintain agreements, and within three days prices fell by £2 10s. In February of the present year, there was an effort to re-establish the association, which, however, only ended in the final winding up. Midland makers in particular have suffered severely from this collapse, because the manufacturer on the sea-board escapes the heavy railway rates, and can under-quote the midland maker every time. The collapse of the association has removed the temptation to flood the market with material, and it is likely that the establishment of new plants has reached its limit for some time to come. In this connection, it is likely that more will be heard of the new form of corrugated sheets described in The Iron Trade Review some time ago, the grooving of which enables fitting to be effected without punching or piercing the plates. The system is growing rapidly in favor and a company is about to be formed for turning out the material on a large scale.

Activity in Tin Plate.

Throughout the year, tin plate has occupied an enviable position with all the mills full of work and books congested with orders. Prices have not advanced correspondingly, but have maintained great firmness. Finished black plates, which commenced the year

at £10 10s, are now quoted at £11 15s. and are very difficult to obtain. Standard tin plates have also advanced from 13s 3d to 14s 7½d. Probably about 50 mills have been opened during the year, employing from 1,000 to 1,400 men, and the home trade, which gives employment to 22,000, has been driving ahead very actively during the year. A remarkable feature has been that America has been one of the trade's best customers.

The steel trade has had a solid flow of business and would have done still better but for the unfortunate boilermakers' lockout, which has continued practically since the spring. Semi-finished steel has remained in the neighborhood of £5 to £5 2s 6d all the year except for a slight relapse to £4 17s 6d during the late summer. But even this was not general. The steadiness has undoubtedly been due to the moderate dimensions of foreign competition. A marked feature of business is that the dumping of materials on the old reckless scale, apparently almost regardless of price, has ceased. Fairly large quantities of bars and billets come from Belgium and a few from Germany, but these are sold with a keen eye to profit, and the British manufacturer accordingly has never found himself beaten quite in the old ruthless style. Indeed several large works are increasing their output and are putting down fresh plant, with a view to capturing the orders now taken by the foreigner. Makers of general section steel have done very well, having been fully employed all the year, and selling prices have improved at a fair ratio, relatively to improved demand. Thus, steel angles, which began the year at £6 2s 6d to £6 5s, now sell at £6 12s 6d to £6 15s. Joists have not done quite so well, having advanced merely from £6 5s to £6 10s. A peculiar feature of the trade is that the structural department has never been more than moderately active; but for this structural engineers are themselves partly responsible, a great many new competitors having entered the business, with apparently slight disregard for profits.

Increase in Freights.

Undoubtedly, one reason for the easing off of foreign competition to some extent is the rise in freights, which has coincided with the improvement in the shipping business generally. Continental exportation to Great Britain is, therefore, not quite the tempting business that it was six months ago.

Of such miscellaneous products as strip for tubes, wire for nails and screws, light strip for bedsteads, and hoops for packing and other purposes, small bars for chains, and such material, it is sufficient to say that they have shared in the general improvement of business shown by the improving Board of Trade returns, issued for several months past. That improvement has further been emphasized by the railway returns of business and the improving dividends of the great railway companies. But with regard to this department of trade, it is remarkable that on the whole the railways have been poor buyers. It is only within the past two months that the great builders of rolling stock have been able to realize full time in their shops, and railway purchases from other firms have been correspondingly meager. The Sheffield makers of tires and axles would have fared badly but for foreign orders. The small purchases of railways are commonly explained by the very large company amalgamations and the general disposition among the great lines to reduce competition and arrive at an understanding. Quite a large number of trains, formerly very poorly patronized, have been struck off, and this has greatly economized the rolling stock. At the same time, there are signs that railway equipment is approaching the limit of exhaustion and if, as seems likely, the present healthy condition of business is maintained, the railways must be large buyers next year. Some of them were hard put to it to accommodate the heavy excursion traffic. They would have been in greater straits still if the weather had been better. It may be taken as certain that fairly heavy orders must be placed within the next few months.

Naval Demands.

A general belief, which appears to be well - founded, prevails that navy increases really inaugurated the trade improvement. The government yards have been full of work and practically all the largest shipbuilding firms able to tackle gunboats, torpedo boat destroyers and battleships, have had a share in this naval equipment. This, in turn, caused shipowners to look round and anticipate the evil day when renewal of passenger and freight steamers would involve much heavier outlay. With the keen ocean competition, steamers must quickly become old-fashioned and obsolete, and the life of the battleship is shorter still. Great Britain appears to remain the favorite shipbuilding center for such foreign countries as cannot furnish their own ships, and in addition to British requirements a large amount of foreign naval work and miscellaneous steamship business is in process of construction in our yards. The steadiness of steel prices has aided this very considerably. It is notorious that a previous shipbuilding boom was suddenly and effectually arrested by a rise in ship plates of £1 per ton, which added enormously to the cost of shipbuilding. From this point of view, shipbuilders and shipowners undoubtedly welcome a certain amount of foreign competition in the supply of iron and steel, as this prevents undue temptation on the part of steel manufacturers to put up their prices. This view of matters has figured prominently in the political contests of the present general election. The comparative steadiness of prices is regarded as furnishing a hopeful feature as to prospects of business next year.

The great armament works of Sheffield and on the northeast coast have, during the past six months, had an extremely busy time, and they are all at work either upon vessels for the navy or in furnishing the heavy equipments, castings, driving shafts, turbine drums, etc., for big ocean steamers. Probably all of them are assured of constant activity for the next six months at least. Similarly, the makers of high-speed steel and steel for heavy cutting appliances, such as saws, scythes, etc., have had an excellent year, and are much busier than they were. For special steels, America has, throughout the year, been an excellent customer.

Raw Material.

The position of raw material has been somewhat peculiar and cannot be described as altogether satisfactory. In January, prices for No. 3 Cleveland began at 51s 2d ($12.52) and before the end of the month had increased just a shilling. This seems to have been the high-water mark, as, by June, prices had come down to 49s ($12), where they have remained, with slight fluctuations, ever since, and the year closes with prices still in this neighborhood. The odd circumstance is that pig iron consumption is much larger now than when prices were 2s better. The explanations are really simple. There has been a large increase of stock. Connal's stores, which began the year with 370,000 tons, now contain over the half million, and continue to increase. The crucial element appears to be the withdrawal of American business. Formerly in every trade improvement America has been a good buyer, with the result that prices here have stiffened from 1s to 2s per ton. It was rather hastily assumed a year ago that the coming improvement would bring Americans once more into the market; but this has proved to be a vain hope and is now generally abandoned. The effect has been serious to the dealers and speculators, who have thereby lost thousands of pounds; but the British consumer of pig iron has benefited accordingly in that he has not been required

to pay inflated values for his material. It is notorious that he was never able to get back again from the customer the additional 2s per ton exacted from him through the appearance of the American as a competitive buyer. Lately, there has been talk in Cleveland of the necessity for reduced output and it is likely that some such development will take place. Cleveland is different from Barrow-in-Furness, where output is carefully regulated to the market's requirements, and prices are, therefore, steadier. The hematite pig iron department has been much healthier for the very excellent reason that production and consumption are much more carefully balanced than on the northeast coast.

A marked feature of the northeastern exports has been in every quarter of the year a steadily increasing proportion of finished materials as compared with raw material, a development which is generally welcomed, as for years past it was felt that the dispatch of tens of thousands of tons of pig iron to be worked up by other nations represented a somewhat unhealthy condition of affairs.

Trade Organization.

The year has not been remarkable in the matter of trade organization. Several attempts have been made by the South Staffordshire makers of unmarked bars to arrive at some agreement as to selling prices with a view to arrest the ruthless and destructive competition which has prevailed all the year, but the attempts have completely failed and with somewhat old-fashioned plants at some of the works frequent surprise is expressed that these manufacturers manage to keep in fairly regular operation. It is notorious that profits are cut ruinously. More success has rewarded the efforts to combine the manufacturers in the galvanized hollow-ware industry, a most important branch of the sheet trade. The necessity was urgent, because the rise in black plates, amounting to £2 per ton in a short period, had not been followed by any corresponding advance in selling prices. The movement commenced in the autumn, and is understood to have been completely successful, all the manufacturers of importance having been brought into the agreement, and at least two advances in selling prices have been declared and maintained as a result. The Scotch Steelmakers' Association, in spite of some little bickering, has managed to retain control of the business, and this combination appears to be working smoothly. As the year closes, there is news of a new combination intended to cover the Scottish malleable iron trade somewhat on the far-reaching system prevalent on the continent by which output is pooled and distributed, but it is doubtful whether this will come to anything. Apparently such combinations do not thrive very well on British soil.

Labor Disputes.

The ugly blot on the year has been the succession of serious labor disputes. There was a great coal strike in the north of England in the spring. In the autumn, there was a very extensive stoppage of a northern railway which shut up a number of collieries and necessitated the damping down of furnaces. The boilermakers' lockout is still with us, after prevailing for nine months, and is doing untold mischief. The basis of fight in that trade war is the refusal of the men to carry out the agreement with their employers, made in their name by their own representatives, and the claim suddenly to cease work, in some cases upon impulse, and upon the slightest grievance. For this the employers wish to impose a penalty and though the men's leaders assented, the artisans themselves have repeatedly rejected this advice and matters are at a deadlock. The stoppage is causing widespread distress and staving off a large number of shipbuilding orders. The latest report is that the intervention of the Board of Trade may, if present hopes are realized, bring about peace by the end of the year. The dispute has happily been without those outbreaks of violence which have marked the more recent coal dispute in South Wales, involving 70,000 or 80,000 workmen, in which there has been great destruction of property, and special police have had to be drafted into the district. In this case, government intervention has also been invoked with hopes of success. It is the most remarkable and significant feature that all our large labor disputes for a long time past have been settled by government intervention. Happily, the iron and steel trades have gone on pacifically, except for one dispute in South Wales, which continued many months in connection with the large sheet works, owned by Messrs. Summers & Sons. This was really due to mutual jealousies and hostilities between two of the men's unions, but in this case the record of self-government which has prevailed in the iron trade for the last three or four decades was broken, because, like our biggest disputes, this was settled through the pacific overtures of the Board of Trade.

Political Unrest.

The iron and steel trades have figured somewhat prominently before the public this year, owing to the political unrest and the feverish controversy over tariffs. Leading ironmasters have championed the respective sides, and among the tariff reformers are such well-known ironmasters as Ebenezer Parkes and Stanley Baldwin, both of whom have seats in parliament. It is believed that in the January election, the iron-making town of West Bromwich was won for tariff reform by a circular emanating from a number of manufacturers which promised the workmen 50 per cent more work if tariff reform were adopted. A similar circular was issued in the election decided three days ago, but in this case the tariff reform majority of 800 was reduced to five. The non-success of unionists' polls appears to show that tariff reform has made very slight progress, although some allowance must be made for the fact that this election is mainly over the House of Lords. Undoubtedly, the tariff reformers have had a very uphill task, since the trade recovery exhibited in such a marked manner in the Board of Trade returns.

International Amenities.

In recording the principal events of the year, mention must be made of the meeting between British and American engineers which took place in Birmingham last summer, and so greatly strengthened the cordial feeling existing between the two countries. The meetings were perfectly harmonious and fraternal, and were regarded by both the British and Americans taking part as among the most delightful and memorable experiences of their lives. More recently, a large number of prominent iron and steel masters have taken part in the meeting of the American Iron and Steel Institute, and since their return have spoken in enthusiastic terms of the cordiality and warmth of their American reception.

Hopeful Outlook.

The outlook for the coming year is considered hopeful. It seems likely that the election now in progress will settle the long-standing controversy on the Constitutional question, and business men generally would be very glad to be relieved of the unrest which has so greatly interfered with commerce for some months past. In regard to the international outlook, the somewhat disquieting messages as to the condition of American trade are regarded as furnishing a discouraging feature, but it is hoped that this may improve. As far as British and Continental trade is concerned, it is believed that a good year is in prospect, although nobody expects that a boom will be reached. If labor and politics would cease from troubling, it seems likely that the optimistic expectations may be realized.

THE ABC OF IRON AND STEEL

Under this title will be published a series of articles in which will be discussed, in a semi-popular, semi-technical style, the successive stages of iron and steel manufacture, from the ore to the finished product. These articles will be presented to meet an insistent demand for an elementary work on the iron and steel business of this country, in which not only the practical, but the commercial phases of the industry are comprehensively considered. Experts in their respective vocations will contribute to the series which will be published in THE IRON TRADE REVIEW, *in natural sequence, from time to time during the year.*

The subjects of some of the articles and the authors who have already been retained, follow:

"Iron Ore"—John Birkinbine.
"Transportation of Iron Ore on the Great Lakes"—Ralph D. Williams.
"Ore-Handling at Lower Lake Ports"—Walter G. Stephan.
"Blast Furnace Practice and Pig Iron"—John Jermain Porter.
"Wrought Iron"—John P. Roe.
"Bessemer Steel Practice"—Bradley Stoughton.
"Open-Hearth Steel Practice"—Kenneth Seaver.
"Sheets and Tin Plate"—B. E. V. Luty.
"Coke"—J. R. Campbell.

Other articles will be included on "Crucible Steel Practice," "Electric Melting Furnaces," "Duplex and Other Steel Melting Processes," "Merchant Steel," "Structural Steel," "Plates," "Wire and Wire Products," "Pipes and Tubes," "By-Product Coke," "Gray Iron Foundry Practice," "Steel Foundry Practice," "Malleable Foundry Practice" and "The Production of Non-Ferrous Metal Castings."

Iron Ore and Mining Operations

By John Birkinbine

POSSIBLY no factor in our national development has been more potent than iron ores, for in the early history of the iron industry their utilization made the nation self-dependent and added greatly to the country's wealth, and as population increased, iron production created commercial and manufacturing centers, some of which are among the most noted cities of the present. The consumption of 50,000,000 tons of iron ore per annum has been made possible by advanced mining methods, by improved land and water transportation equipment, by marvelous appliances for transferring the ore from railway cars to vessels, and again from vessels to cars, by systems for handling large units at the blast furnaces, by economic smelting, and by the processes through which the metal produced passes while being fabricated into forms suitable for commercial use, admirably adapted to secure the best result in product with the least consumption of fuel.

JOHN BIRKINBINE

The bulk of the domestic iron ore used in the United States is not touched by the hand of man from the time it leaves the mine until it is in form for sale as rails, structural shapes, wire rods, sheets, merchant bars, etc., and in many of the operations the ore is dug by power shovels, or "milled" through chutes, so that even in mining but little hand labor is necessary. Lifted from its bed by buckets on power shovels, ore is loaded into railway cars or directed through "mills" into chutes, or mined by pick and shovel, shot into mine tram cars which run to pockets feeding skips, which are raised by power and automatically dumped into waiting railway cars, except when climatic conditions, stagnant trade, or the desirability of continuing operations require that ore be stocked for future shipment. Where necessary the ore

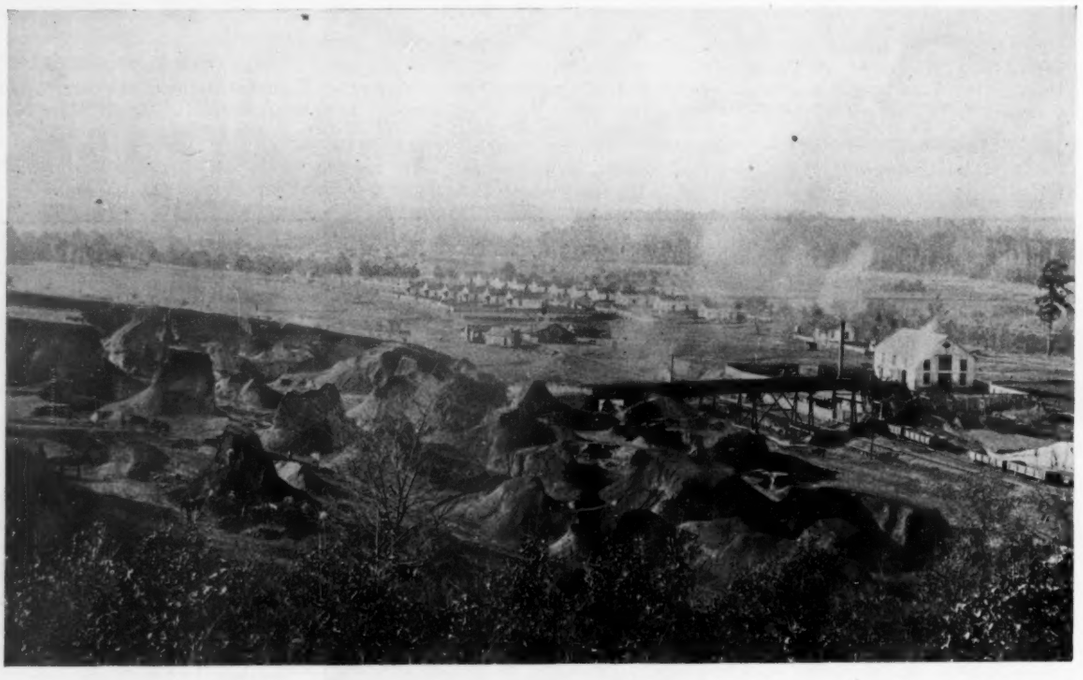
passes through intermediate crushers to reduce the size of pieces; but in crushing, stocking or reloading man directs the movement of machinery and touches but little of the ore.

Railway cars, with their loads of iron ore, convey it to blast furnaces, or, as is the custom with most Lake Superior ores, to docks provided with pockets into which the ore drops through the opened bottoms of the cars, spouts connecting with the dock pockets delivering the ore by gravity into vessel holds. At the end of the vessel's trip, mechanical devices remove the ore and deposit it in cars or on stock piles. When the furnace, to which the ore is consigned, is reached, the railway cars drop their contents onto stock piles or into bins from which the ore is chuted to charging cars, which convey the ore to and dump it into the furnace top.

As lake navigation is suspended for five months in the year on account of ice, stock piles are accumulated at the mines, at receiving docks, at lower lake ports, and at the blast furnaces, where elaborate mechanical appliances facilitate the handling of this ore when used.

The streams of molten metal tapped from blast furnaces fill ponderous ladle cars, in which it is conveyed to mixers so as to maintain a uniform quality of iron, and provide for interferences during subsequent treatment, or it is carried to casting machines to be formed in a series of moving molds into cold pig iron, or run out into pig molds made in the sand floor of the casting house, and is subsequently loaded into cars for shipment to customers.

Where the direct production of steel is desired, the mixer feeds molten metal to other ladle cars, which convey their contents to open-hearth furnaces or to Bessemer converters, and from these the converted steel is tapped to form ingots, which, while hot, pass to soaking pits and thence to the rolls where they are fabricated into commercial forms.



AN OPEN-CUT BROWN HEMATITE MINE IN ALABAMA WITH TRAM CONNECTION TO WASHER. THE IRREGULAR CONES ARE MOSTLY BARREN OR LEAN MATERIAL FROM ABOUT WHICH THE RICHER ORE HAS BEEN MINED

By the use of mechanical appliances, ore, therefore, passes from the bed, vein or lens, where nature formed it, to the finished shapes ready for the market, without being touched by the hand of man, and without being allowed to become cold from the time the ore enters the blast furnace. This description is applicable to the bulk of the ore used, but there are a number of mines where hand-mining, and in some, hand-drilling, are practiced.

Our history covers but four centuries, in which a wilderness of three and one-half mil-

lion square miles has been transformed into a nation with nearly a hundred million population, engaged in agriculture, manufacture, mining and other features of development. The country is gridironed by 334,000 miles of railroad connecting magnificent cities, important towns and countless villages of comfortable homes, which have grown at a rate seemingly impossible to other nations. A development so rapid was necessarily made by the waste of much of our natural resources, and the iron ore supply has shared in this, although waste has been proportionately less in iron ore than in forest or coal. However, to obtain the greatest value from the iron ore deposits they must be conserved, that is, utilized judiciously and with care for the future.

The Lake Superior region, which supplies 80 per cent of our domestic iron ore, is to be credited with many improvements and much industrial development. The immense quantities of ore to be handled developed the steam shovel from a machine of moderate power to one of great capacity, and many advances in mining appliances and special mining methods resulted from the exploitation of the immense ore bodies. Larger railway cars required stronger locomotives, and hundreds of miles of railway, dependent upon iron ore mining, opened much new territory to settlement. Three railroads in Minnesota built specially for carrying iron ores, aggregate over 700 miles, with an equipment of 282 engines, and over 16,700 cars. The shipping and discharging docks provided facilities for expeditious and cheap ore handling, encouraged special types of steamship construction, and have placed upon the great lakes an unparalleled fleet, which carries, probably, 80,000,000 tons of freight.

The development of Lake Superior iron ores and of the copper mines, together with the grain, lumber and coal carried, has resulted in encircling the lakes with railroads, in the construction of the great canal locks, in the creation of harbors and caused the building of large cities, with varied industries. Nor is this improvement confined to the lake region. Without Lake Superior iron ores, Pittsburg would not be the thriving manufacturing center of today. Youngstown and neighboring cities, Wheeling, Steubenville, Johnstown and other important sections would support but a small fraction of their present industries and population, notwithstanding the advantages of local fuel, or river transportation, which they have. Much of the advance of Buffalo, Duluth, Ashland, Marquette, Escanaba, Chicago, Milwaukee, Cleveland.

MINING BROWN HEMATITE WITH STEAM SHOVEL IN ALABAMA, SHOWING THE ORE IN PLACE, EXTENT OF STRIPPING, ETC. THIS IS ONE OF THE PROPERTIES OF THE TENNESSEE COAL, IRON & RAILROAD CO.

Toledo and Detroit is to be credited to iron ore, while Gary, Lorain, Ashtabula, Conneaut and Tonawanda, may be considered as creations due to the utilization of this useful mineral.

In other portions of the country, similar, if not as pronounced results, have followed, and Pueblo, Colo., Birmingham and Sheffield, Ala., Chattanooga, Tenn., southern Virginia, the Susquehanna, Schuylkill and Lehigh valleys of Pennsylvania, northern New Jersey, northeastern New York, owe much of their present development to the use of iron ores. In some of these, the abundance of fuel and flux, and the convenience to market, have had a marked influence, but in most instances the present status could not have been attained without an abundant supply of iron ore. In fact, the mining of this mineral, its transportation, its use and its conversion into commercial forms, have demanded the best thought, the greatest ingenuity, and the highest chemical and physical research, and there are few lines of manufacture whose present advanced condition is not largely due to the ability of the country to furnish iron ore in quantity sufficient for the demands of the people.

A feature worthy of comment, while not confined to iron ore mining, is the provision made by mining companies for the comfort and safety of employes, evidenced by desirable homes, attractive reading rooms, well-equipped changing houses, inspection of machinery, equipment and mine workings, care as to the use of explosives, etc.

A resource which has been so potent in our national advancement is, therefore, well worthy of conservation, not by holding the deposits for future generations, but by utilizing them in the most economical manner. While some of the iron ore reserves of the country have been sacrificed, or their productive capacity limited by injudicious or wasteful methods, and while instances could be quoted where these still prevail, most of the iron ore won is attained by the application of mechanical appliances, and the employment of technical knowledge, such as to warrant the assertion that, as a rule, iron ore is mined on a basis such as will conserve it.

MINING HARD, RED HEMATITE ORE AT THE NORTH JACKSON MINE, MARQUETTE RANGE, NEAR NEGAUNEE, MICH.

Recognizing the importance of an iron ore supply, many developed properties, and some explored, but undeveloped, have been secured by large manufacturing interests, which also control transportation routes and equipment. While this foresight provides mineral for the plants of these companies, and while the ore bodies, so controlled, represent a large proportion of those now developed, they cannot be assumed as placing the iron ore supply of the country in the hands of a limited number of owners.

With no desire to appear unmindful as to

the future, or to encourage any waste, loss, or careless method, the writer believes that the present known and undetermined but probable sources of iron ore give little cause for anxiety as to the prospective prosperity of the United States. In the sections of the country where iron ore has been won for a century or more, deposits which were dormant, because they were worked by costly or wasteful methods, may be revived, and in these sections we hear of new discoveries. In districts where systematic exploration has been carried on, reports of additional reserves warrant the expectation of continued activity, and in the portions of the country which have been but imperfectly explored, there are known iron ore deposits of magnitude which may be supplemented by others, which subsequent developments may bring into use.

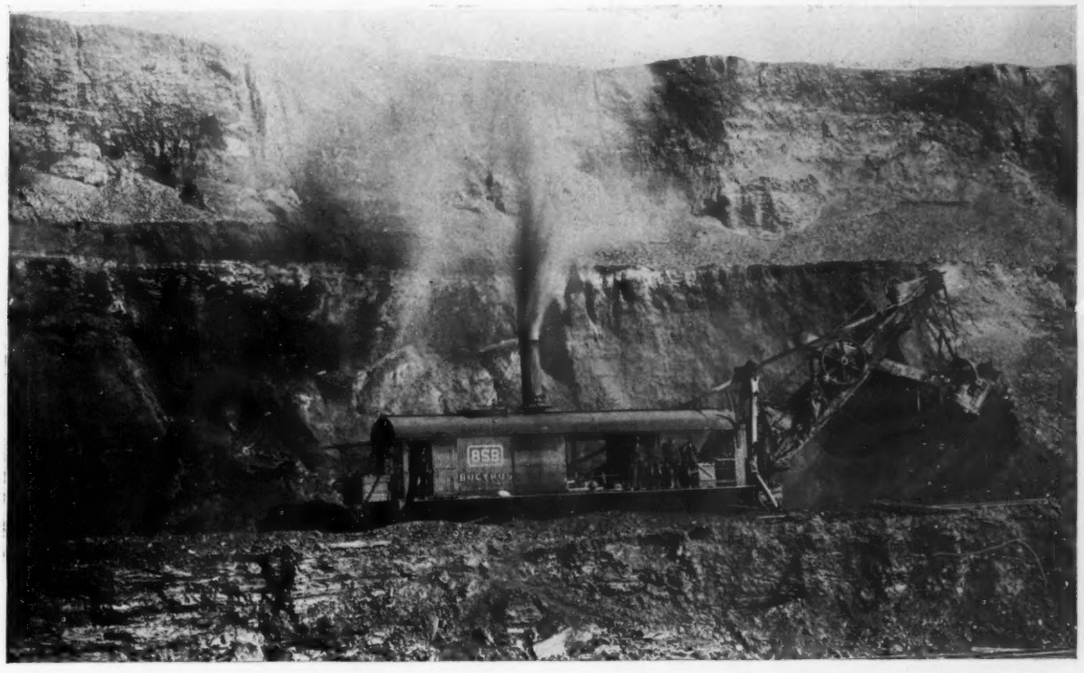
The abundance of desirable iron ores has also limited the use of those requiring beneficiation, either because of leanness, or the presence of constituents considered undesirable, and with an ample fuel supply this country may, if necessary, draw on others where the utilization of ore is impracticable.

Every invention, analysis, or process which cheapens the output of the mines, the handling, or transportation of the ore, the conversion of the iron, and its manipulation into forms demanded by the market is in the line of conservation.

We are not justified in assuming that in the processes used we have attained the best method of treating ores. When the steel industry seemed menaced by a scarcity of ores of Bessemer grade, the development of the open-hearth furnace relieved the anxiety, and if in the future some deficiency should be apparent, it is probable that technical education and practical instruction will open fields which will encourage the use of iron ores now unwrought.

Electricity, apparently, offers means of producing desirable metals from ores which are objectionable by the methods now followed. Electric smelting may not be economical, except where ores are high in iron, cheaply obtained, and where current can be supplied at low cost per kilowatt hour. But electric refining, evidently, offers a means of converting metal whose composition limits its use by methods now generally followed, into one of most desirable character, and we can scarcely claim to have passed the threshhold of electro-metallurgy as applied to iron and steel manufacture. Ores at present condemned, or but lightly valued, may prove the basis of future utilization, and some constituents, now avoided, may be appreciated as imparting desirable characteristics to finished products.

Few elements are found in greater abundance, or in more varied associations, than



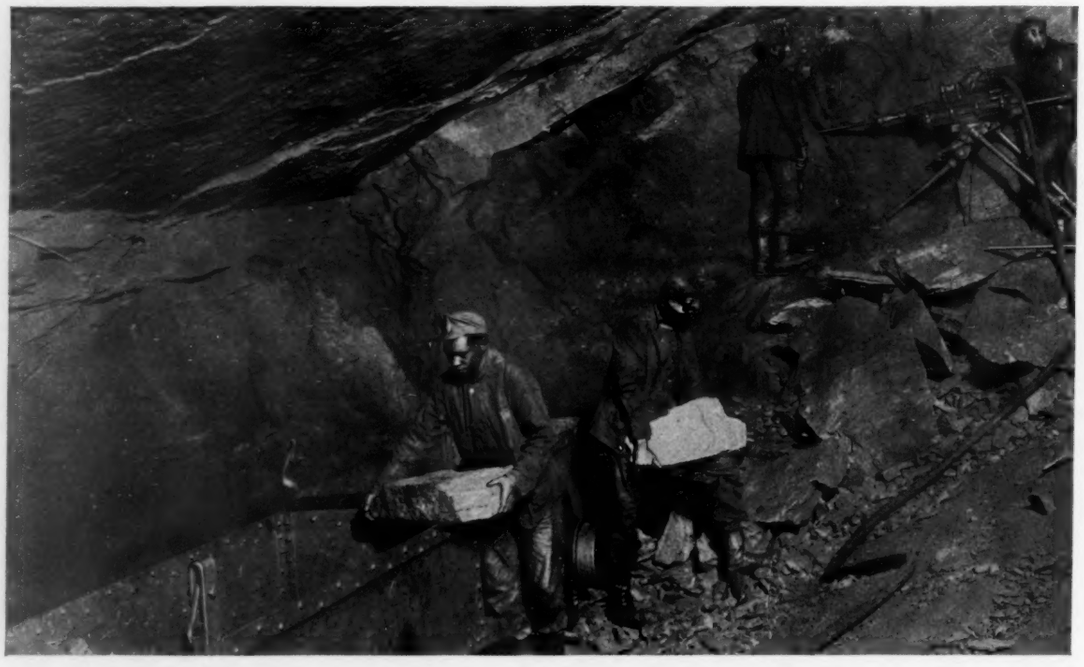
A 95-Ton Steam Shovel Operating on One of the Properties of the Oliver Iron Mining Co., at Hibbing, Minn.

iron, for this is present, not only in iron ores proper, which contain a preponderance of the metal, but also in varying amounts in manganese ores, in sulphides, particularly the pyrite division, in minerals of zinc, lead, chrome, copper, arsenic, ochres, graphite, platinum, iridium, osmium, talc, emery, in all the aluminum compounds except the gems, in antimony, bismuth, in practically in all of the earth's clays and rocks, having been found as grains in basaltic rocks, and in the metal gold in minute quantities. The rocks of the globe, with their most common minerals, are made up of 13 elements, among which iron is prominent. The wide distribution of iron ore has often been mentioned, for it occurs in many rocks, mainly as oxides, sulphides, or carbonates, but it is only when the iron predominates over associated metals or compounds that the term iron ore may be applied to the mineral.

In every state of the Union, iron ores have been found, not necessarily in amount, composition, or locality to invite immediate development and use, although many deposits now dormant may become active sources of supply in the future. Twenty-six states are at present contributing to the iron ore output of the United States, which, in volume, greatly exceeds that of any other country.

The relative quantities reported as produced by important contributors to the world's iron ore supply are, approximately, as follows:

	Tons.
United States	52,000,000
Great Britain	15,000,000
Germany and Luxemburg	25,500,000
France	10,000,000
Spain	9,000,000
Russia	6,000,000
Sweden	5,000,000
Austria-Hungary	4,000,000
Newfoundand	1,000,000
Cuba	1,000,000
Algeria	1,000,000



MINING HARD HEMATITE ORE IN THE BIRMINGHAM DISTRICT OF ALABAMA, SHOWING THE THICKNESS OF SEAM, THE METHOD OF MINING WITH A POWER DRILL AND THE LAMINATED CHARACTER OF ORE BEING LOADED INTO CARS. THIS MINE IS ONE OF THE PROPERTIES OF THE TENNESSEE COAL, IRON & RAILROAD CO.

The United States uses practically all of the iron ores mined within its limits, and in addition, imported over 2,000,000 tons last year from Cuba, Spain, Sweden, Canada and Newfoundland, Africa and other countries.

Imports of earlier years were as follows:

Iron Ore Imports, Calendar Years, Gross Tons.	
1903	980,440
1904	487,613
1905	845,651
1906	1,060,390
1907	1,229,168
1908	776,898
1909	1,696,411

Sources of Imports in 1910.*

	October.	Ten Months.
Spain	6,250	401,612
Sweden	36.177	209,017
Canada	19,729	140,040
Cuba	137,250	1,251,960
†Other countries	20,165	216,859
Totals	219,571	2,219,488

Some domestic ore is also exported. The country, therefore, may be considered as able to maintain its iron and steel industry upon domestic ores, differing in this respect from England, Germany, Belgium and France which depend, to a larger extent, upon iron ores obtained from other nations. Spain, Sweden, Newfoundland, Algeria, Cuba, Italy and Greece produce more ore than is used within their boundaries. China, Brazil, Mexico and Venezuela are among those which promise large supplies for the future, and exploration will undoubtedly demonstrate important deposits elsewhere. Prof. Rich Akerman, the noted metallurgist of Sweden, gives the world's production of iron ore in 1907 as 136,000,000 metric tons, and as 116,000,000 metric tons in 1908.

The chairman of the United States Steel Corporation recently presented the following alternate estimates, indicating the late past, present and future iron ore requirements of the United States and Canada:

	Long Tons.
1880	7,000,000
1890	16,000,000
1900	27,500,000
1909	53,000,000
1920	78,500,000 to 102,000,000
1930	104,000,000 to 197,000,000

The importance of the iron ore supply for the future was also emphasized at the International Congress of Geologists, held at Stockholm, Sweden, at which there was a symposium on this subject. No apologies are, therefore, required for a detailed consideration of the character and uses of iron ores.

PILLARS OF MAGNETITE IRON ORE IN NO. 2 MINE OF THE PORT HENRY IRON ORE CO., MINEVILLE, N. Y., SHOWING PORTION FROM WHICH THE ROOF HAS BEEN BLOWN DOWN. PRESENT OPERATIONS ARE CARRIED ON BY UNDERGROUND MINING

Native iron is occasionally met with in small quantity, mostly as aerolites. None of phenomenal size has been discovered in this country, but our neighbor, Mexico, has received a number of these celestial visitors. In the city of Mexico one is exhibited, the two portions of which aggregate 25 tons in weight, and another specimen of meteoric iron weighs 11 tons. The meteorite brought by Lieut. Peary from North Greenland weighs 37½ tons. This meteoric iron is mainly an alloy of iron and nickel.

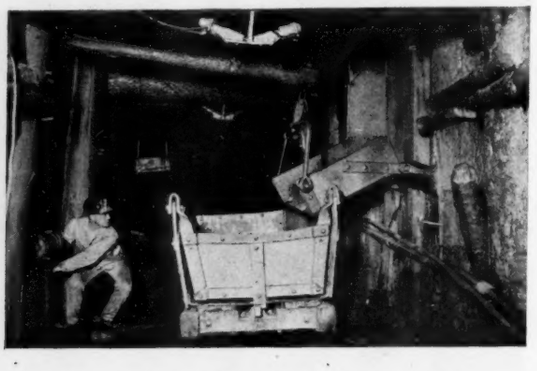
Although an iron ore may, in itself, be

*U. S. Government report.
†Newfoundland is included in these totals.

desirable, it is not commercially valuable unless it can be mined and transported to a market at a profit.

The iron ores of commerce are oxides, that is, combinations of iron and oxygen, generally associated with earthy materials, for, although some carbonates—minerals in which iron occurs with oxygen and carbon as carbonic acid and sulphides—combinations of iron with sulphur—are used, these ores are generally roasted to drive off the carbonic acid in the former and reduce the sulphur in the latter. In fact, sulphides, as such, are not smelted to produce iron. A considerable amount of "blue billy" or purple ore, is fed to blast furnaces, but this is a by-product, resulting from roasting sulphides to produce sulphuric acid. Iron ores in which sulphur exists in moderate amounts are also used without treatment, but when the proportion of sulphur in an iron ore is 1 per cent or more, this amount must be reduced by treatment.

MINING RED HEMATITE UNDERGROUND AT THE CLIFFS SHAFT MINE, MARQUETTE RANGE, ISHPEMING, MICH.



VIEW IN DRIFT, SHOWING ORE CHUTE AND TRAM CAR

While iron ores are used as a flux to facilitate the smelting of other metals, for paints and other purposes in moderate amount, their importance is based upon converting them into metallic iron, which is accomplished principally by charging iron ore, fuel and flux into blast furnaces. The fuel, whose combustion is accelerated by highly heated air, supplies the gas necessary to reduce the oxide, and the heat to melt the metal, the flux, usually limestone, uniting with the impurities of the ore to form a cinder, or slag, which is withdrawn from the furnace as it accumulates, and at intervals the liquid metal is tapped into vessels for further treatment, or cast into forms convenient for handling and use, which is the pig iron of trade. Some iron ore is also fed to open-hearth steel furnaces, and it is being successfully smelted by means of electricity, but the bulk of the iron ore produced, in this country and throughout the world, passes through the smelting process in blast furnaces.

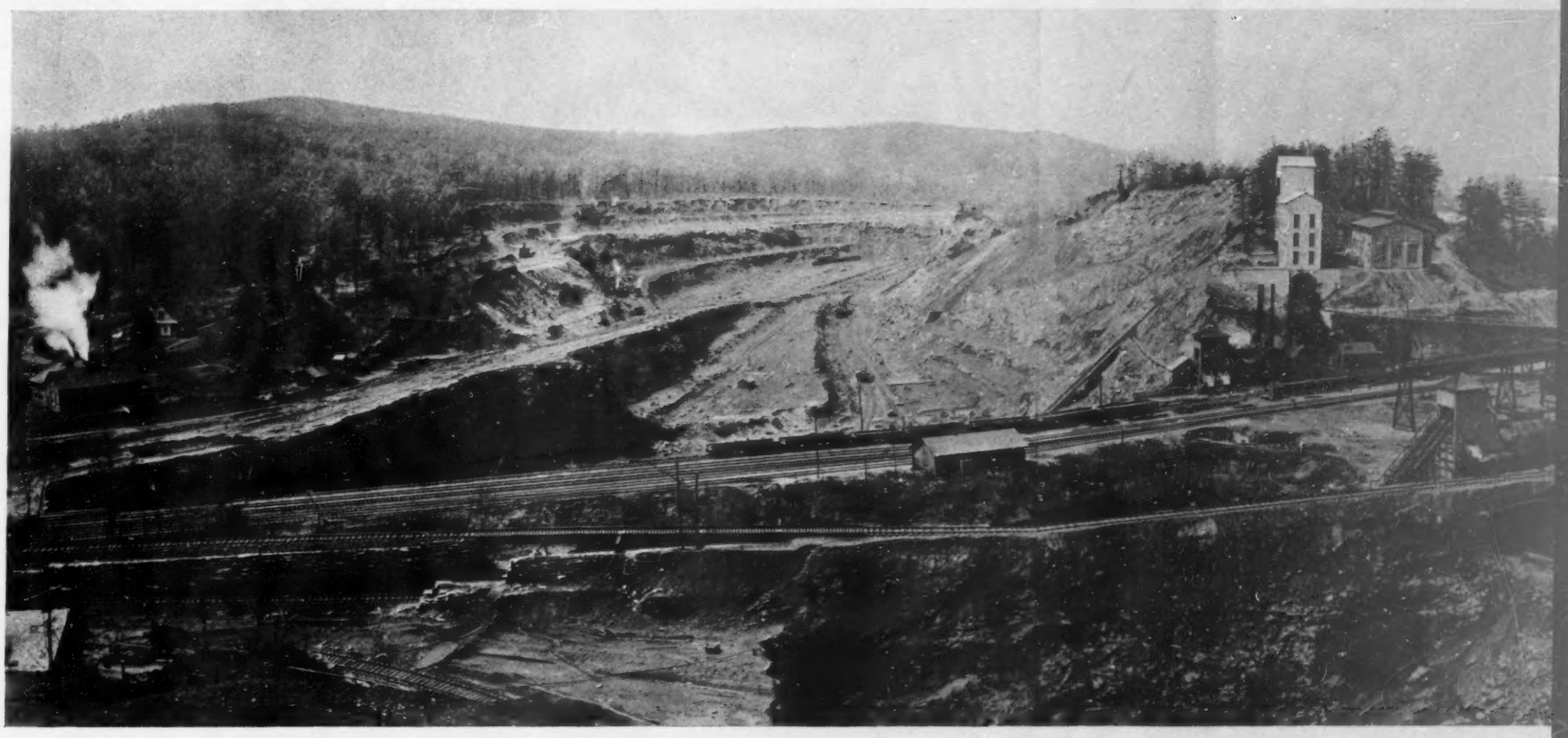
The ancient method of producing iron in an open fire of charcoal is only in use where limited product and high cost of manufacture make these permissible, and the Catalan forges, which were abundant in this country one-half century ago, are all abandoned.

Iron ores are mineralogically classified into four general divisions, which, in the United States, rank in order according to amounts used, as follows: Red hematites, brown hematites or limonites, magnetites, and carbonates. Distinctive or local names are applied to various ores of these general divisions, and it is not unusual to find ore of two of these classes in the same deposit.

Red Hematite, derived from the Greek word for blood, is recognized chemically as sesquioxide of iron, there being three parts of oxygen to two of iron, or as peroxide of iron, the maximum proportion of oxygen to the metal, or as ferric oxide, indicating that this is the maximum degree of oxidation. As all chemical combinations are based on atomic weights, iron being 56 and oxygen 16, the formula for red hematite—Fe_2O_3—gives, when pure, 70 per cent of iron and 30 per cent of oxygen, and has a hardness as compared with talc from 5.5 to 6.5, with a specific gravity 4.2 to 5.2 times the weight of water. *It is an anhydrous oxide, that is, contains no water of combination after being exposed to a temperature of 212 degrees Fahr. The mineral gives a reddish streak on a porcelain plate.

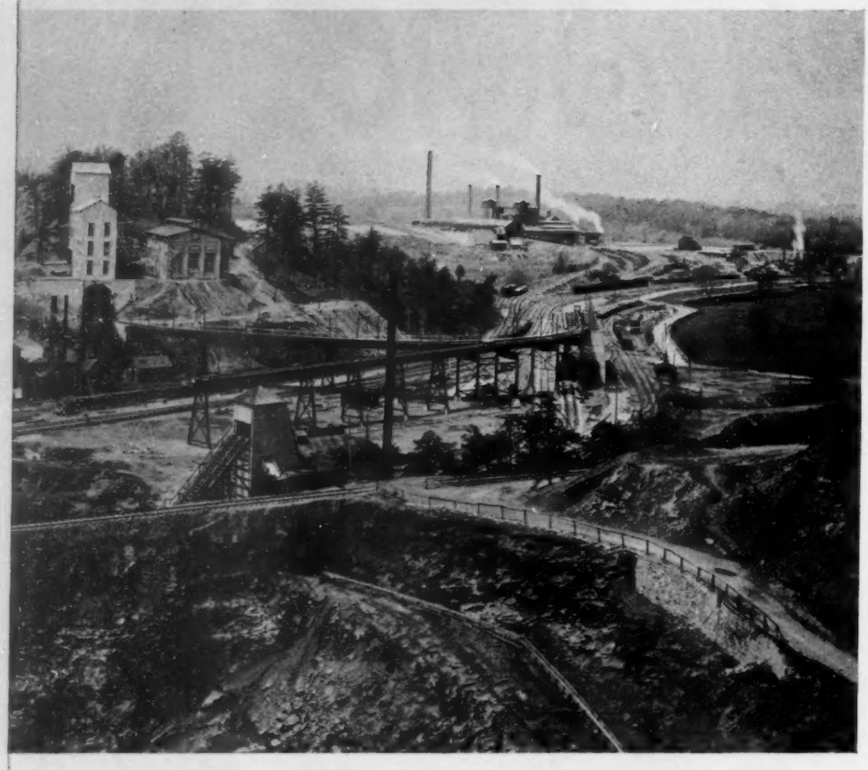
Approximately 90 per cent of the iron ores mined and commercially used in the United

*Mineralogical descriptions and formula given in this article are taken from Dana's "Manual of Mineralogy."



Panoramic View of Portion of Cornwall Ore Hills, Pennsylvania, Showing Extensive Open Cut Working in Magnetite, with Electric Power Station, and Blast Furnaces in the Distance at the Right.

Mining Soft Red Hematite Ore by Steam Shovel at the Old Stevenson Mine, Mesabi Range, Minn., the New Shaft Bei Portion Shows Ore, and the Lighter Stripping.



UT WORKING IN MAGNETITE, WITH STRIPPING, STEEL INCLINES,
TANCE AT THE RIGHT.

E, MINN., THE NEW SHAFT BEING INDICATED. THE DARKER
IPPING.

States are classed as red hematites, the amounts produced being:

	Long Tons.
1907	46,060,486
1908	31,788,164
1909	47,000,000 (estimated)

Most of the Lake Superior ores are of this class, and the major portions of the ores mined in Alabama, Tennessee, Georgia, Nevada, Wyoming and considerable amounts from New York, Pennsylvania, Kentucky, Missouri, Virginia and central Wisconsin, are red hematites. Of foreign ores, those from Cuba, Canada and Newfoundland are largely red hematites.

Brown Hematite, or limonite, is of the same general composition as red hematite, but contains water, its chemical formula—Fe_2O_3 H_2O—showing 85.6 parts sesquioxide of iron, and 14.4 water. It contains, when pure, 60 per cent of metallic iron, but is seldom so found. Generally of a brown or yellow color, it assumes various forms, with a fibrous structure, also massive and at times earthy. When powdered, it gives a brown or brownish-yellow streak on the porcelain plate. Its hardness varies from 5 to 5.5, and the specific gravity from 3.6 to 4.4.

ROTARY TIPPLE, ELECTRICALLY-OPERATED, AT FOOT OF JOKER SHAFT, MINEVILLE, N. Y. LOADED MINE CARS ARE RUN INTO THE TIPPLE AND DISCHARGED

BREAKING DOWN AND LOADING MAGNETITE IRON ORE IN THE JOKER MINE OF WITHERBEE, SHERMAN & CO., MINEVILLE, N. Y.

"Swank's Iron In All Ages" credits Virginia and Massachusetts as initiating the iron industry of the United States. These works, as well as other early ones adjacent to the Atlantic coast, depended upon brown hematite ores.

Late records show that brown hematite ores were produced in the following amounts in the United States:

	Long Tons.
1907	2,957,477
1908	2,620,390
1909	3,000,000 (estimated)

These were obtained from Virginia, Alabama, Georgia, Tennessee, Pennsylvania, New York, Connecticut, Massachusetts, Texas, Missouri, Colorado, Washington, West Virginia, Montana and Wisconsin. Most of the ores imported from Spain, and some from Cuba, are classified as brown hematite.

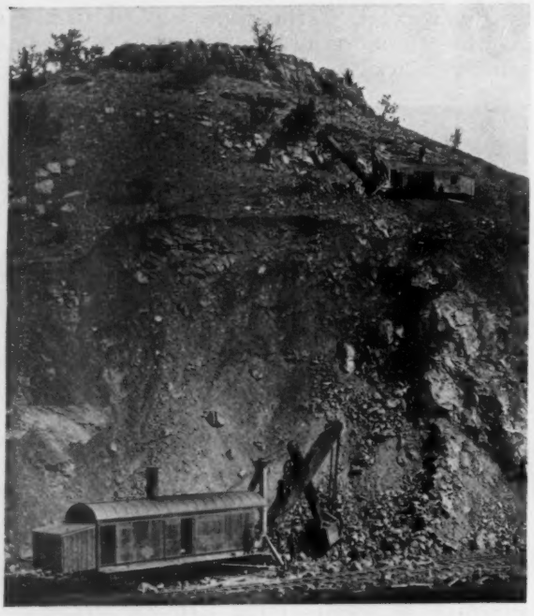
Many of the brown hematite ores occur in clay deposits, and to make them available the material mined is washed to remove clay and gravel, and to further facilitate their utilization, some are roasted. Few are sufficiently free from phosphorus to be within the accepted Bessemer limit, although from a deposit in Colorado over a million tons of ore, very low in phosphorus, have been won. Sulphur is seldom troublesome in brown hematites, but they are often associated with manganese in considerable amount.

Magnetite, so-called because it is attracted by the magnet, is the term applied to ores in which iron occurs as a magnetic oxide, usually black or blue-black, steel-gray or greenish in color, giving a black streak on the porcelain plate. When pure its chemical symbol is Fe_3O_4, or iron 72.4, and oxygen 27.6 per cent, representing sesquioxide of iron 68.97 and protoxide of iron (one part of iron to one part oxygen) 31.03 parts. It varies in hardness from 5 to 6.5, and in specific gravity from 4.9 to 5.2. Deposits of this class of ore are mostly associated with crystalline rocks, and are abundant in metamorphic rocks, although also found in grains in eruptive rocks.

The preceding statements indicate that, in chemical composition, magetite is the purest form of iron ore in nature, but many of the available ores carry sulphur, phosphorus, titanium, or other elements in such proportion as to limit their utilization, while in other localities the magnetite crystals are associated with an excess of rock, making them too lean for economical smelting. Magnetites, as

mined, are practically anhydrous, and as suggested by their specific gravity, are dense. Their crystalline character is also evident. Probably the purest iron ore mined in the United States was some 40,000 tons of magnetite obtained from Moriah, near Port Henry, N. Y., which averaged 68.6 per cent of metallic iron, and one-third of the analyses made show the presence of 70 to 72 per cent iron. Other prominent states contributing magnetites are Pennsylvania, New Jersey, North Carolina and New Mexico.

The Lake Champlain-Adirondack region of northern New York has numerous large deposits of magnetite. Some of these produce lean ore, low in phosphorus, which is enriched by magnetic separation. Other ores,



HANDLING RED HEMATITE IRON ORE AND STRIPPING WITH A 90-TON STEAM SHOVEL AT THE MINE OF THE COLORADO FUEL & IRON CO., SUNRISE, WYOMING

high in iron contents, carry phosphorus in excess, which is reduced by the use of magnetic separators, the phosphorus tailings being sold to blast furnaces producing foundry iron or used for fertilizer. Other magnetite ores are titaniferous, that is, contain titanium, and on this account are not in demand, although experiments in furnace operation suggest that the objection to the use of titaniferous iron ores may be based largely on prejudice, and when these enormous deposits have satisfactory railroad connections, the ore will find a ready sale.

In southeastern New York, large amounts of lean magnetite exist which will require beneficiating to make them desirable for blast furnace use, and 400,000 to 500,000 tons of magnetite are annually won from mines in New Jersey. Pennsylvania also has a number of magnetite mines, the largest being the Cornwall Ore Hills, from which an average output of 600,000 tons per year is taken by open workings. From the deposit, which has been wrought for 170 years, a lean, sulphurous Bessemer magnetite is won at such low cost as to encourage beneficiation by roasting, magnetic separation and nodulizing. The recovery of about one-half of 1 per cent of copper present in the ore also reduces the cost of any treatment given.

Other large deposits of magnetite are in Virginia, North Carolina, New Mexico, Utah,

STEEL SHAFT HOUSE AT THE JOKER PIT, WITHERBEE, SHERMAN & CO., MINEVILLE, N. Y., HANDLING MAGNETITE 900 FEET BELOW GROUND

Nevada and Wyoming. At various localities, the sands of the seashore, or along river banks, have magnetite disseminated through them in quantity sufficient to encourage their use by beneficiation. The production of magnetites in the United States was as follows in 1907, 1908 and 1909:

	Long Tons.
1907	2,679,067
1908	1,547,797
1909	2,700,000 (estimated)

The importations of Swedish iron ores are magnetites.

Carbonate iron ores have the chemical formula of FeO, CO_2, that is, one part of protoxide to one part of carbonic acid, or, as

commonly expressed, $FeCO_3$, yielding carbonic acid 37.9, protoxide of iron 62.1. When chemically pure this would be equivalent to 48.3 per cent of metallic iron. The ore, generally gray, yellow, buff and brown in color, shows hardness 3.5 to 4.5, and specific gravity 3.7 to 3.9. The carbonate ores are also known as "siderite," and earthy, or impure varieties, from mixtures of clay and sand, are called "clay ironstones." The concretionary form is known as "spheresiderite" and "niggerhead" ore. It is also recognized as "black band," "spathic" iron ore, etc.

The iron industry of the Hanging Rock region, along the Ohio river, and that of eastern Ohio and western Pennsylvania, and part of that of Maryland, developed by the use of carbonate ores, many of which were oxidized to limonites, but the relatively thin beds in the coal measures from which carbonates are mined, and the desirability of roasting them to drive off carbonic acid, has limited their use, as Lake Superior or foreign ores have supplanted carbonates in most localities, but the latter may be a factor of importance as future reserves.

Carbonate iron ores, or their derivatives, have been obtained in New York, Pennsylvania, Ohio, Maryland, Kentucky, Indiana, Illinois and Mississippi, Ohio being the main source of supply, which, in late years, has furnished from 24,000 to 27,000 tons. The ironstone and blackened ores of England and Scotland have been important factors in the pig iron industry of Great Britain.

Local or indicating names are given to iron ores, such as "flaxseed", "blue", "brown," "manganiferous", "limestone", etc., due to their shape or color, or to the principal mineral associated with them. Iron ores imported are known as "Porman", "Seriphos", "Juragua", "Elba Lavata", "Elba Andante", "Mokta", "Marbella", "Somorostro", "Kirunavaara", "Gellivare", "Rubio", etc., usually indicating the locality or mine from which the iron ore is obtained.

"Blue Billy", the residuum from iron pyrites, from which the sulphur has been extracted, mill cinder, roll or hammer scale, etc., are also used in the production of pig iron.

Knowing the chemical composition of an ore, the proportion of iron which it contains may be determined by multiplying the per cent of FeO by 0.77777. Similarly the per cent of Fe_2O_3 multiplied by 0.7, or Fe_3O_4 multiplied by 0.72413, or $FeCO_3$ multiplied by 0.48275, will show the content of metallic iron. These factors are given because there is often apparent confusion in interpreting analyses, and it is not unusual to hear statements to the effect that an ore contains 80 or more per cent of iron, evidently due to the fact that the party who makes the statement assumes that the oxide of iron reported is metallic iron. As above noted, magnetite is the purest form of iron ore, and the maximum limit of metallic iron in this is 72.4 per cent. Therefore, any ore reported in excess of this yield may be classed as a practical impossibility, unless native or meteoric iron is referred to, whose occurrence is too rare to be considered on a commercial basis.

The extraordinary high grade magnetite obtained from Moriah, New York, may be considered as an unique occurrence, and was referred to because of the unusual richness of a small part of the product of the mines. As indicating the tendency to over-rate the iron contents of ores a pretentious book upon Mexico, published in England in 1909 refers to a noted iron ore deposit as a hill "containing 460,000,000 tons of iron ore assaying 70 to 75 per cent of pure iron." The author who appends to his name the title "civil and mining engineer" evidently was not aware that the ore in this deposit was red hematite, which if entirely free from any other elements than iron and oxygen (which

CRATERS FORMED BY MILLING SOFT-RED HEMATITE ORE, MESABI RANGE, MINN.

EXCAVATING THE ORE BODY, THE INITIAL STEP IN THE MECHANICAL HANDLING OF IRON ORE

it is not) could not yield over 70 per cent of iron, and that even pure magnetite would not supply 75 per cent of the metal.

As previously stated, iron ores are seldom found pure, the oxides being usually associated with silica, lime, magnesia, alumina, sulphur, phosphorus, copper, titanium, manganese, chrome, etc., in varying quantities, most of which detract from the value of the ore.

The earthy materials, silica, lime, alumina and magnesia, limit the richness of an iron ore, but such as have fluxing qualities may more than balance the tendency to leanness. When copper is present to about 1 per cent, the value of this metal may compensate for its recovery as incidental to improving the iron ore in advance of smelting. While the other metals each form desirable alloys with iron, they may each limit the commercial value of an iron ore when present in moderate amounts. Thus, manganiferous iron ores may be sought for when manganiferous pig iron, or spiegeleisen, is to be made, but otherwise the presence of manganese would, for some uses, be considered disadvantageous. Ferro-chrome and ferro-titanium are produced by electro-metallurgical processes, but neither chrome nor titanium is considered desirable in an iron ore smelted in a blast furnace. The abundance of ore carrying these elements, and their satisfactory composition as far as other elements are concerned, promise, however, to bring them into greater favor. Sulphur is objectionable because it must be removed from the blast furnace by the use of additional flux, requiring an increased consumption of fuel, with a lessened output, and it is generally considered advantageous to reduce the amount of sulphur in an ore by treatment before feeding it to a blast furnace. In the pig iron made, sulphur is also undesirable, because of its interference with manipulating the iron or steel with which it is associated in the rolls, or because of augmenting shrinkage of castings. Phosphorus, while desirable in moderate amounts in producing pig iron for foundry use, is tabooed in metal fed to the Bessemer converter.

The manufacture of steel by the Bessemer process has been instrumental in dividing much of the ore used into two general classes, Bessemer and non-Bessemer ores. A Bessemer ore is one which is, or can be used in the manufacture of pig iron for subsequent conversion into steel by the Bessemer process, in which molten metal is treated in a converter. In this conversion, the phosphorus is retained, and Bessemer pig iron must not contain over one part of phosphorus in 1,000 of iron, or, expressed in percentages, 0.1 per cent of phosphorus to 100 of iron. But as the phosphorus in the fuel and limestone fed to the furnace may also enter the pig iron, the practical trade Bessemer limit approaches 1 in 1,400. Iron ores, which do not conform to this standard, are generally classed as non-Bessemer, and may not command as high a price as the Bessemer ores of equal iron content and physical conditions. To such a nicety is this differentiation carried that increments or decraments of 0.001 per cent of phosphorus, or one-third of an ounce in a long ton, may affect the commercial value of the ore.

High grade Bessemer ores can be mixed with non-Bessemer ores so that the resulting mixtures will come within the Bessemer limit, thus securing a combination at lower cost than if the high grade Bessemer ores alone were used. But the growth of the open-hearth steel industry has resulted in creating a market for iron ores containing moderate amounts of phosphorus, although low percentages of this element are desirable for this branch of the industry. The basic Bessemer process, which uses high phosphorus ores, has not proven successful in the United States.

Other things being equal, the physical character of an iron ore influences its value. Thus, the ores from the Mesabi range in Minnesota, which, as a rule, are finely comminuted, are sold at 25 cents per ton less for Bessemer and 20 cents per ton less than non-Bessemer old range ores. When ore is finely divided it is objectionable to handle or transport, and its use encourages an excessive amount of blast furnace flue dust, which is either lost or recovered at considerable expense. An accumulation of fine material in the blast furnace develops slips and irregular working, and when these slips carry down large amounts of coke dust, severe explosions are likely to result. Magnetites are considered as less readily reduced by blast furnace gases than hematites, owing to the greater freedom with which the latter part with the oxygen, and to the usually denser character of the former. But many of the comparisons made were with lumpy magnetite and finer divided hematite.

The density and hardness of an ore, or, on the contrary, its open, porous structure, the mechanical means, or with which it decrepitates in the furnace, affect the value of iron ores. Another factor of moment is the amount of moisture, for most of the mineral, in addition to combined water, carries hygroscopic moisture which is driven off in the early part of the blast furnace operation. This moisture, like the earthy impurities of an iron ore, must be paid for in transporting it and as a result nearly all iron ores are mar-

keted based upon their composition when dried at 212 degrees Fahr., or 100 degrees Cent. The importance of considering the hygroscope moisture is evident from the following table, which illustrates the per cent of iron in some of the standard Lake Superior ores in their natural state, and when dried as above:

Iron and Moisture in Certain Lake Superior Iron Ores.

	Natural State.		Dried at 212 deg. Fahr.
	Iron, per cent	Moisture, per cent	Iron, per cent
Red hematite, hard.....	64.7	0.75	65.19
Red hematite, hard.....	64.89	0.82	65.43
Red Hematite	57.4	10.42	64.05
Red Hematite	54.3	10.90	60.90
Red Hematite	55.23	6.91	59.33
Red Hematite	51.43	13.00	59.12

In brown hematites, the percentage of water is usually greater than that indicated in the table.

The practice, which formerly prevailed, of charging into the blast furnace large lumps of ore, has given place to preparation which reduces the ore and also the flux to smaller sizes, and at important mines or quarries powerful crushing plants are installed to produce material of desirable size for shipping, handling and use in the blast furnace.

The percentage of iron in the ore, independent of the other elements which will make it commercially valuable, at the present time varies in different sections of the country, and this is also dependent on the ease of mining, distance to a market, freight rates, etc. Thus, in the Lake Superior region, the greater portion of the product of which is transported long distances to a market, iron ore has been used as a ballast on roads, or laid aside as a reserve, which, in the southern states, would be considered valuable at the present time as iron ore. It is also possible to utilize an iron ore carrying a comparatively low percentage of iron, when other elements are combined to make it of value for some special purpose. Thus, low grade siliceous ores are mined in the Lake Superior region, and find a ready market as a mixture with certain Mesabi ores. The principal reliance of the Birmingham, Ala., district is on the hard Clinton ores, which will average about 38 per cent of iron, but as this ore contains lime it requires less flux in the furnace, and being close to centers of pig iron production, is used in large quantities; but this same ore, at the present time, would hardly be considered of value if it were necessary to transport it long distances to blast furnaces. Many low grade iron ores may be made salable by beneficiation, as carried out on a large scale with the Lake Champlain magnetites, or by roasting and jigging.

The duty on foreign iron ores, formerly 40 cents per long ton, now reduced to 15 cents, or, in the case of Cuban ores, 32 and 12 cents, respectively, restricts the use of these ores to the Atlantic and Pacific seaboards, but the reduction in this duty has enabled the foreign iron ores to compete to a greater extent with domestic ores, and the quantity imported has shown a large augmentation.

The general practice and principles of mining apply to iron ore as to any other mineral, but as the majority of metalliferous ores carry greater money value per unit of weight there are a number of features peculiar to iron ore mining. Quantity is the *desideratum* aimed at, and a mineral which carries the metal or its compounds in large proportion is necessarily treated differently from one which holds these in small *modicums*. The wide distribution of iron ores, and the fact that they have been mined in this country for more than two centuries, and in other countries for a longer interval, have brought into play most of the methods adopted for other ores, modified to meet local conidtions.

Iron mining may be, and is, carried on on moderate scale, but as a rule it is necessary to win large quantities to make the operation successful. Ample product must be assured to warrant the construction of transportation facilities, and where beneficiation is necessary the erection of a suitable plant must be provided for, and in most exploitations some mechanical means for hauling, hoisting, pumping water, lighting, operating drills and occasionally ventilation, are necessities. These demand liberal initial expenditures.

The earlier mining operations were entirely by hand labor, supplemented by animal power; the pick and shovel removed the earthy covering and subsequently the ore, which was hauled away from the opening to ore dumps and to near-by furnaces in wagons or carts. Later, ore was passed through washers for improvement, and, when underground mining was necessary, this was done by the crude appliances then available. In isolated locations the older method may still be in use, and in some European countries this is more common, but the value of labor in the United States, the great demand for ore, and the necessity for conveying much of it long distances, have resulted in the application of unexcelled appliances and advanced methods of mining, handling and transporting the mineral.

For the supply of the blast furnaces of the United States it is probable that the average

transportation of domestic iron ores from mine to furnace approximates 600 miles. Possibly the fairness of this estimate may be questioned, because the bulk of the Lake Superior ores, and some of the Lake Champlain ores, have the advantage of cheap water transportation, which permits of long hauls at low ton-mile rates, but iron ore from the mines in the Lake Superior district reaches the shipping docks by railroad connections of from 15 to 100 miles, the lake transportation averaging about 800 miles, and the ore must be removed from the vessel at receiving docks, loaded on cars and shipped to furnaces, a few of which are close at hand, but the majority of the ore reaching lower lake ports covers an average of fully 100 miles of railway transportation before it is delivered to the furnaces which consume it.

Where the ore lies in a large continuous body, is capped by unproductive earth or mineral, it can either be removed by the open-cut or the underground method, the former prevailing where the cover is soft and of moderate depth, the latter where the cover is solid rock, or where the vein has a tendency to deepen. This does not apply in all cases, some ores with an earthy cover being worked underground, and the rock capping of other ore bodies having been removed. The extent to which stripping for open-cut mining can be carried depends upon the depth of the ore in relation to the thickness of stripping, but with the modern appliances in use, this stripping has, on large deposits, been extended to a depth over 100 feet. Heavy stripping is also employed where the "milling" method is followed.

The apparent advantage of open-cut mining is to be discounted by the necessity of caring for a large amount of surface water accumulated from rains or snows, the interference with operations on stormy days, and the saturation of material by water or melted snow, as well as by the necessity of disposing of the large quantities of stripped material removed, for until the definite limits of the ore deposit are determined, there is a risk of covering future reserves by the accumulation of waste if placed close to the mine, but in open-cut working practically all the ore can be recovered. The money invested in removing stripping before the mine can be economically attacked imposes heavy financial burdens, and in underground operations, initial investments are required in driving adits or entries, slopes or shafts, and in providing hoisting or pumping appliances. By the use of power drills and mechanical underground transportation, supplemented by economic machinery to handle ore and water, underground mining has the preference, except where explorations have demonstrated bodies of ore of sufficient magnitude to encourage the removal of the overlying material of moderate thickness.

Methods employed in winning iron ore are influenced by the physical and geological conditions of the deposits, their apparent extent, their relation to surface, the character of rocks or earthy materials with which the ore occurs, the strike, dip and pitch of the ore body, and the chemical composition of the mineral to be mined, also the location of the deposit as related to the market and the financial ability of the operator. The deposits may be classed as beds, masses of mineral, either in their original position or tilted by subsequent action; lenses or pods, irregular-shaped masses of ore imbedded in, and separated by earth or rock, and veins which fill crevices or seams, the walls generally being fairly well defined.

Where an ore deposit has a general surface or horizontal direction, this is known as the strike; where this direction departs from the horizontal the amount of depression is the pitch, while the general vertical angle made by the ore is the dip. Thus, a deposit described as having a strike N. 40 degrees E, pitch 10 degrees north and dip 70 degrees E, describes one whose general direction is northeast and southwest, dipping towards the north so as to make an angle of 10 degrees with the horizon, the body also being upon a steep angle, 70 degrees from the horizontal, towards the east.

Most of the larger deposits now wrought have been explored by drilling at various points on the property, the cores obtained showing the material through which the drill passed. In this way the size of the deposit, its shape, composition of the ore and its enclosing rock, etc., can be approximately determined, and plans for mining intelligently laid out. While mining is being prosecuted, diamond or other drills are used in advance of underground working to determine the best way in which to mine the ore, or in case a fault or slip (displacement or sliding of the ore vein) or (horse-intrusion of barren material) has occurred, to determine how the ore can be again reached to best advantage, beyond the slip or horse. The drills indicating whether the vein pinches out, in other words, ends, or at some point further on widens out again, so that it will be again profitable to win the ore.

When the deposit of ore is covered to a considerable depth, or if the vein is narrow, dipping at steep angles, it is mined by means of shafts, either vertical or inclined, and through tunnels or adits. As the shafts, or adits, are costly and are to be used during

the entire life of the deposit, they must be located and planned with care. In most of the large mines, shafts are divided into sections, ore being raised on all but one section, which is reserved for manways and handling water, timber, etc. Unless the stratum through which the shaft is sunk is exceptionally compact and hard, substantial timbering is necessary to insure permanence, and it is driven either in the ore, or preferably in the supporting rock, so as to be free from disturbance. If placed in the ore, then sufficient ore is left about it to safeguard against destruction. Some late shaft installations are made of concrete (often reinforced) or steel, and the headworks at some of the shafts are of excellent construction, embodying steel framework, metal pockets, and the hauling and pumping apparatus is of high efficiency.

From the shafts, drifts or levels are run at different depths, with cross-cuts to rooms or stopes where the ore is excavated. If the deposit dips considerably, one method of mining is to work a series of levels simultaneously, the upper drifts or levels being further advanced than those below, the ore being taken out in horizontal sections or slices, known as stopes. When ore is mined above a given level and allowed to fall by gravity, through chutes or otherwise, the method is recognized as *overhand stoping*. Where it is worked below a level and the ore won is raised, it is named *underhand stoping*. The former is in most cases easier, cheaper and more advantageous.

In underground working the space made void by the removal of the ore must be filled, in part at least, either by timbering, or by rock or other waste material. If the ore is left in pillars alternating with rooms or stopes, these may safely support the roof, but often the ore, so left, is too valuable to make this method desirable. The adits or drifts having been connected with the shaft or slope, the ore is removed by either of the following systems:

Milling is especially adapted to shallow deposits of soft ore, such as are found on the Mesabi range in Minnesota. In this case the earthy cover is removed from the ore body, and drifts run across the deposit from which *raises* are made, and the ore, when broken down around the *raises*, forms large sinks or craters, falling through chutes to tram cars in the drifts or adits, to be sent to the shaft and thence to the surface.

Caving consists of taking the ore from a series of levels connected with the main shaft, the ore being dug from upper levels and delivered by chutes to lower adits, which are securely protected. As the ore is removed from the upper level, the roof is allowed to settle upon the ore below. Thus, little ore need be left in a deposit, and there is not great risk of damage to mine or workmen. The ores won by this system are usually soft or moderately so, although it may be adapted to some hard ore mines where the roof, or hanging wall, is insecure.

The slicing system is employed where there is a series of parallel drifts, one advanced more than the other, so that the ore in the deposit is sliced off.

Room mining may be considered as excavating cavities separated by pillars or walls of ore forming rooms of considerable size, sometimes extending from the foot to the hanging wall. The foot wall is the vertical or inclined face which controls the dip of the ore body and supports it. The hanging wall is the rock or other material which rests upon the ore. In many instances the latter and the roof are supported by an arrangement of timbers known as *square sets*, in which timbers form the outlines of a series of cubes placed one above the other. This system permits of winning ore from rooms of enormous size.

Filling is merely a means of protecting workings by depositing in the rooms or cavities waste rock, sand, etc., adopted at some hard ore mines as more economical than maintaining timbering.

In any method of mining, development is kept well ahead of actual mining, so that there need be no cessation of work when a level or section of a deposit is exhausted.

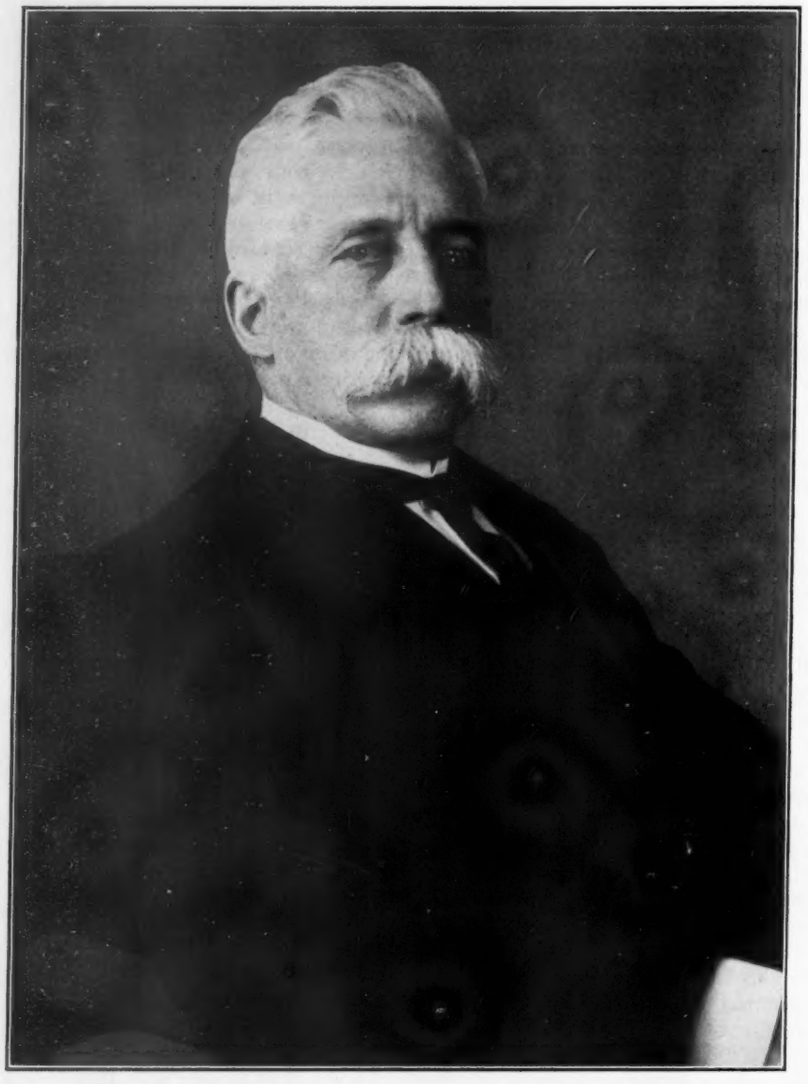
In the Lake Superior region, during the winter months, stocks of ore are accumulated at the mines to await the opening of navigation, and as this necessitates re-handling of the ore, it is customary at this season to restrict the mining of ore as much as possible in underground operations, while in the open-cuts work is generally suspended. In the southern states, however, this is not the case, and underground operations may be carried on continuously.

In this sketch prominence has been properly given to the Lake Superior region, which contributes 80 per cent of the iron ores mined in the United States at the present time, and produces a larger amount than any foreign country. In its history of little more than a half century nearly half a billion tons of iron ore have been won from the Lake Superior region and although it greatly predominates, the amount of iron ore obtained yearly from domestic mines, other than the Lake Superior region, exceeds the production of the entire United States in 1880, and is greater than the annual output of any foreign nation with the exception of Germany and Luxemburg, England, France and Spain.

New President of the A. S. M. E.

Col. Edward Daniel Meier, the newly-elected president of the American Society of Mechanical Engineers, is a native of St. Louis, having been born in that city in 1841. He received his education in the local schools of St. Louis, Washington University, St. Louis, and at the Royal Polytechnic School, Hanover, Germany. His schooling was rounded out by a course of practical shop work as an apprentice with the Mason Machine Works, Taunton, Mass. Upon the outbreak of the civil war, Col. Meier enlisted with the Grey Reserves, the Thirty-second Pennsylvania regiment, and saw active service with the Army of the Potomac until after the battle of Gettysburg. He subsequently served in the Second Massachusetts Battery and also in the United States Engineers' Corps. He finally became a lieutenant in the First Louisiana Cavalry and participated in many engagements in that territory, receiving the surrender of Lieut. General John B. Hood and three members of his staff, May 30, 1865.

Returning to civil life, he was employed in turn by the Rogers Locomotive Works, by the Kansas Pacific railroad and by the Illinois Patent Coke Co. In 1873, he was engaged in the construction and operation of blast furnaces at Bessemer, Ill. In the period of 1875 to 1884, he gave his attention to the cotton industry at St. Louis, as an engineer, and he designed improved machinery for the baling of cotton. The organization of the Heine Safety Boiler Co. by himself followed in 1885 and he has served as its president and chief engineer ever since. He has been secretary and is now president of the American Boiler Manufacturers' Association and has been a leading figure in the preparation and adoption of standard specifications for both boiler construction and material. Col. Meier introduced the Diesel engine into the United States, and he is the consulting engineer of the Diesel Engine Co. For about ten years, he was colonel of the First Regiment of the Missouri National Guard. He is a member of the Grand Army of the Republic and of the Loyal Legion. In his society activities, he is a past president of the Engineers' Club of St. Louis and his work in the American Society of Mechanical Engineers has been leading and notable. He has served on many committees including the finance committee of which he was chairman. He has twice been elected vice president and was senior vice president at the time of his being honored with the presidency.



COL. EDWARD DANIEL MEIER, PRESIDENT OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

High Speed Engine

At the recent Brussels' exposition, the Holland Engineering Works, Amsterdam, exhibited a new, high speed Diesel engine. This engine, which is of 600-horsepower capacity, differs in several important respects from the type which has been made heretofore. The use of a cross-head and guide similar to those of a steam engine, and a hollow, short, water-cooled piston, are the chief differerences. The piston is provided with 12 packing rings to keep in the high pressures of compression and combustion, and is fastened by means of studs to a flange on the piston-rod end. The interior of the piston is kept in communication with the circulating-water supply and discharge by means of two small brass pipes which are fastened to the under side of the piston and slide up and down in two stationary brass barrels mounted on the engine frame. The barrel through which the water is delivered to the piston is provided with a stuffing box, as this water is under slight pressure. The delivery barrel, however, is not packed.

The connecting-rod end is forked, straddling the cross-head block, and the cross-head has one block or slipper running between guides on both sides. The valve motion is also of improved design, for instead of using cams to actuate the short rocking levers which open the inlet and exhaust valves, eccentrics are used.

Electric Smelting of Ore in the United States

An Exhaustive Investigation of the Possibilities of Utilizing Energy From Waste Fuels—Cost of Power

By J. A. Knesche.[1]

One of the most interesting problems at the present time engaging the attention of the metallurgical world is the use of the electric current in the manufacture of iron and steel. Considerable experience has been obtained with the electric steel furnace and the data given to the public at various times regarding the operations of the many steel furnaces in use speak eloquently for this method of making steel. This process of making steel is continually gaining in popularity, and justly so, for the consensus of opinion of all those who have given deep study to this problem is to the effect that the final outcome of this comparatively new method will be a higher grade of material for the various purposes for which steel is now used.

Indeed, if the writer remembers correctly, he saw recently published specifications for steel rails that were more rigid in their requirements of those features pertaining to strength and general safety than any heretofore presented to manufacturers. In the opinion of the author these more rigid specifications are due entirely to the fact that, owing to the superior control of temperature in steel refinement in the electric furnace, a better material is possible with the electric process than with either the Bessemer or the open-hearth process.

The purpose of this paper is not to discuss the workings of the electric steel furnace, but to show the economic possibilities in making pig iron in the electric furnace. The writer was stimulated to this effort by a letter which he received some time since from a leading technical journal* requesting him to investigate the possibility of producing pig iron by the electric method. This letter was written because the experiments with the electric shaft furnace in Domnarfvet, in Sweden, and those carried on by the Canadian government, seemed to furnish sufficient justification for the belief that the time has arrived for the manufacture of pig iron in the electric furnace with reasonable prospects of commercial success when the necessary conditions can be complied with. The idea of the writer of the letter is evident from the following quotation:

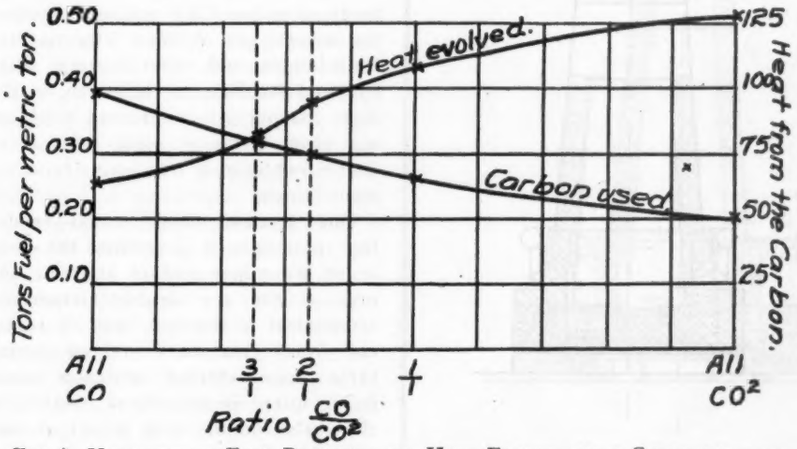


Fig. 1—Variation of Fuel Required and Heat Evolved with Composition of Waste Gases Produced.

> It seems to me now that, with electric current generated by gas engines working in connection with producers, using fuels which are now almost entirely waste, such as slack and the culm which accumulates at the mines, that smelting can be done at even lower cost than is now done with coke, which costs about $2 (this figure corresponds in the original letter to the market price prevailing at the date of writing it, and the author has taken the liberty to change it to suit present conditions) per ton at the ovens, plus freight of $0.75 to Pittsburg, $1.65 to Cleveland and $2.35 to Chicago. There is also a possibility of avoiding freight on fuel entirely over a large area of territory by locating the generating plant at the mines, in which case, of course, the transmission losses would have to be set against the freight charges. If the generating plant and the smelting plant are located together, not all the gas required for the engines would have to be drawn from the producers, since the furnace itself will provide a portion.

At first sight the above looks very plausible and the author was greatly impressed with the possibility of the entire proposition. We have at present 6,000 horsepower gas producer power plants operating with entire success so that with a well trained operating personnel the question of reliability need not be considered. There are records in existence of gas engines running continuously for over 3,000 hours without any stop whatever. Records of this kind must be

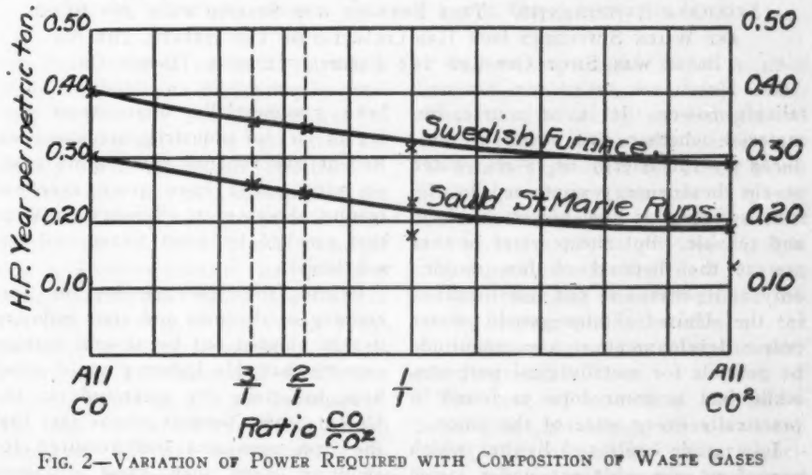


Fig. 2—Variation of Power Required with Composition of Waste Gases Produced.

[1]Wheeling, W. Va.

*The Iron Trade Review.

considered convincing at least to this extent that, with proper care and management and the proper number of reserve machines and producers, no serious trouble will be experienced.

The Question of Power.

After but little study of the problem under consideration the discovery is soon made that in order to make the production of pig iron by the electric method a success one of the first things necessary is cheap, reliable power. It is, of course, immaterial whether the power is produced by the energy of falling water or the heat energy contained in the fuel, so long as the power is cheap and reliable. But cheap water powers are at the disposal of few nations only and perhaps in but few localities in the United States would water power development of any magnitude be possible for metallurgical purposes, while fuel in some form is found in practically every state of the union.

Low grade coals and lignites which are of no use whatever under steam boilers produce excellent gas for gas engines and thus it seems that in certain localities iron industries might be located which could not be brought thither were it not for the fuel. At the fuel testing plant in St. Louis several of the poorest grades of bituminous coal have shown remarkable efficiencies in the gas producer; lignites and peats have also been used with great success, thus opening the way to the introduction of cheap power into large districts which have thus far been commercially unimportant owing to lack of industrial opportunities. Recent experiments with "bone coal" or mine refuse have given excellent results, showing an efficiency equal to that reached by good steam coal under boilers.

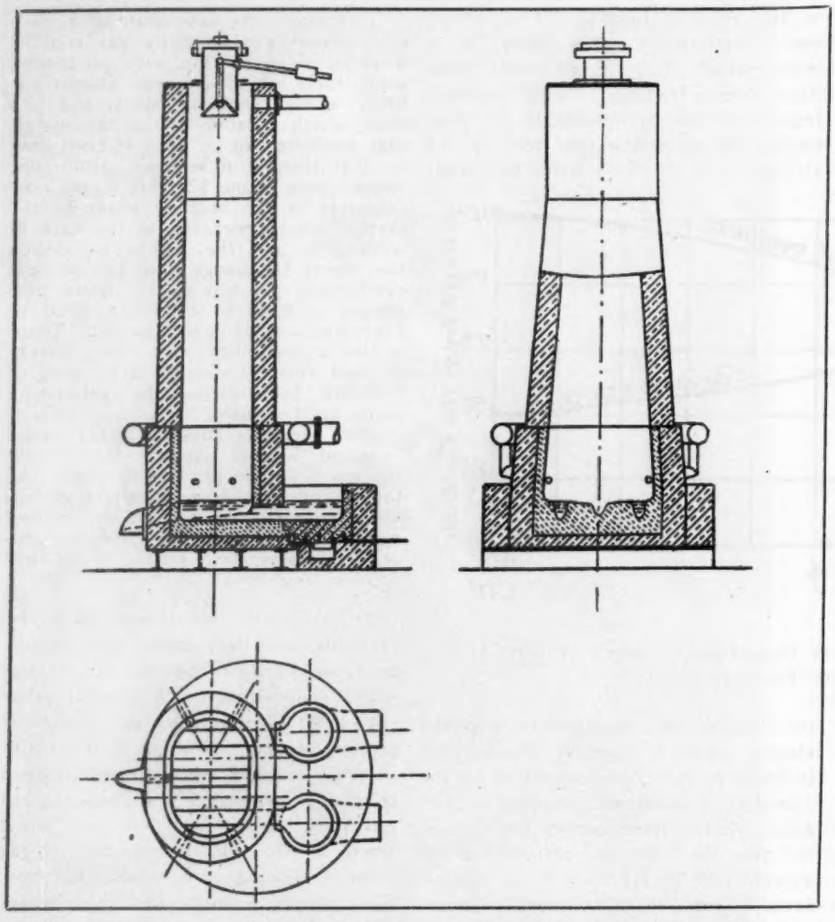


FIG. 3—FIRST TYPE OF SHAFT FURNACE WITH WHICH GRONWALL, LINDBLAD AND STALHANE EXPERIMENTED. THIS FURNACE WAS STARTED WITH AIR BLAST AND WHEN SUFFICIENT IRON HAD COLLECTED ON THE HEARTH, THE AIR BLAST WAS SHUT OFF AND THE ELECTRIC CURRENT TURNED ON.

Before the development in this country of the iron and steel industry it was pointed out by several foreign experts that this industry could never hope to attain any magnitude in the United States because of the fact that the iron ores and fuel required for smelting were such great distances apart that the cost of pig iron would be excessive by reason of the great transportation charges. Looking back to this prediction and bearing in mind the present state of the industry, one is impressed with the possible error in human judgment; but the point which we desire to make in this connection is the following: In the past we have transported the iron ores to the fuel fields of the Appalachian slopes; why not transport the fuel to the ores either as gas or electric energy? To transport the fuel to the ores would seem to be much cheaper than to transport the ores to the fuel. If the distance between ores and fuel is too great the fuel could be converted into producer gas at the mines; this producer gas could be transmitted in high pressure mains for hundreds of miles. We are now sending the natural gas of West Virginia into Philadelphia and other eastern cities and to Lake Erie on the north; in the same manner we could send producer gas equal distances. This idea is of course not new; it has been advocated many times.

One feature which would render the operations of generating the power at the mines and of smelting the ores at the ore deposits especially economical is the fact that all refuse and waste materials created during these manufacturing processes could be deposited in the places vacated by the coals and the ores, a fact of considerable importance when it is remembered that in large power plants and smelting works many tons of refuse, ashes, slag, etc., must be hauled away every day.

In the preceding discussion we have shown that owing to the large coal deposits the question of obtaining power in localities where all other conditions might warrant the establishment of an electro-metallurgical industry, is apparently a minor one. But this is only apparently so, as will appear later on.

By-Product-Recovery Power Plant Most Suitable, and Probable Installation Cost of Plant.

After the author had been working for some time on the problem under consideration it became evident that in order to make a commercial success with an electric smelting plant it is absolutely necessary to produce the electric power at the lowest possible cost. It was therefore soon seen that to produce the power in a producer gas power plant at the lowest cost it would be necessary to install a by-product-recovery plant, providing

of course the fuel used in the producer is suitable for a profitable by-product recovery. All coals are not equally suitable for use in by-product producers. There may be localities which have excellent ores for the production of pig iron in the electric furnace but these localities do not have coals suitable for use in a producer plant with by-product recovery. In case electro-metallurgical operations were to be carried on in such a region it might be found necessary to use some other type of producer with ensuing greater cost per horsepower year.

Bituminous coal containing 1.3 per cent nitrogen will generally yield about 90 pounds of sulphate of ammonia per ton of coal used; but this figure is liable to vary, and of two coals containing the same amount of carbon and nitrogen respectively, more ammonia is recoverable from that coal in which more carbon exists in the fixed form as compared with the volatile form.

In view of what has been said in the last few paragraphs we will assume that an electro-smelting plant is to be located in a district well supplied with a good grade of bituminous coal suitable for use in by-product recovery gas producers; hydro-electric power is not available in the assumed locality. For the present case it is immaterial whether or not this smelting plant is located near the ore deposits, since the question which we are now investigating is whether power for the furnace could be produced at a cost which would make electric smelting a success.

Our problem then will be to work out the operating costs of a by-product producer gas power plant equipped with the necessary reserve machines and producers and capable of furnishing current for a smelting plant which is to have a daily average production of 100 tons of iron.* In the experiments at Domnarfvet in Sweden it was demonstrated that on an average, between 3,000 and 4,000 horsepower hours are required per ton of iron produced. It was further conceded by those making the experiments that with large furnaces it would be possible to produce a ton of pig iron with a power expenditure of one-third horsepower year. The minimum power requirement under ideal operating conditions is between 1,500 and 1,600 horsepower hours per ton of iron, which ideal conditions may perhaps never be reached under normal operation of the plant. Assuming then for our problem that one-third horsepower year is required per ton of iron and that 8,400 horsepower hours constitute one horsepower year, a daily production of 100 tons would require $\frac{100}{24} \times 8{,}400 \times 0.33$ or 11,550 H. P. in the power plant. With the necessary reserves in the producers and the engines the plant would come to about 15,000 horsepower. The writer worked out the details of the cost of such a plant carefully and he found the total cost to be $95 per horsepower of completed plant. For the sake of brevity these details are omitted.

*Except where otherwise noted the gross ton (2,240 pounds) is used in these calculations.

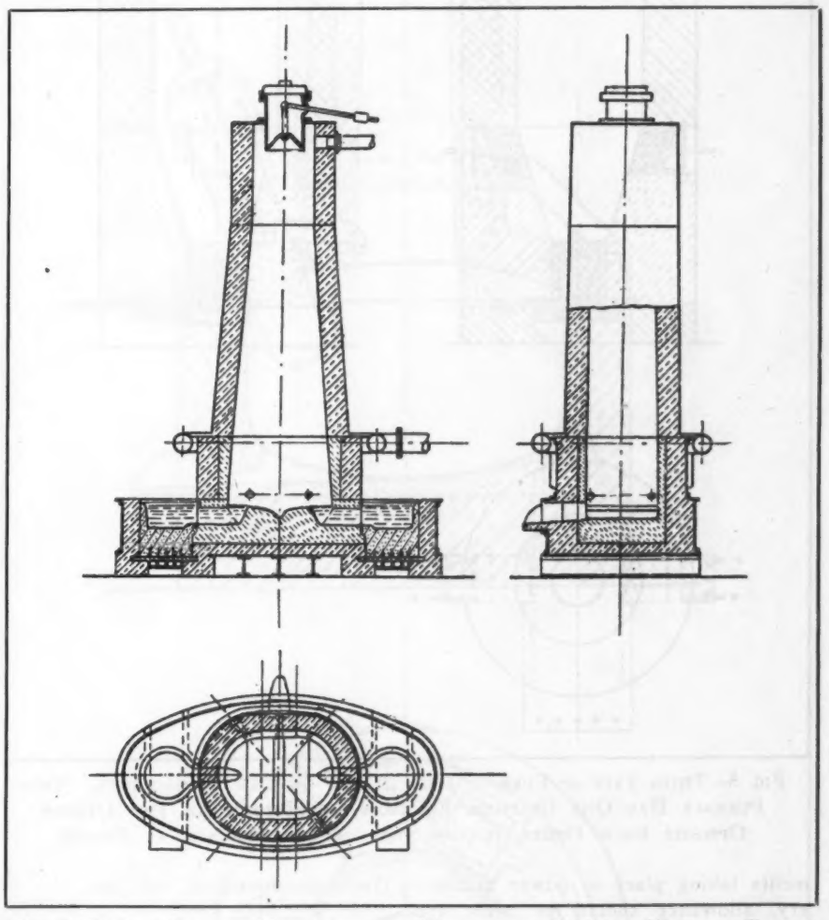


FIG. 4—SECOND TYPE OF FURNACE WITH WHICH THE SWEDISH WORKERS EXPERIMENTED. MOST IMPORTANT ALTERATION FROM FIG. 3 IS IN THE LINING.

Some time ago at a meeting of the American Society of Mechanical Engineers Prof. R. H. Fernald reported that a 5,500-horsepower gas producer power plant was under construction and that the cost of this power plant, including producers, engines, electric generators, buildings and auxiliaries, erected, would be $73 per horsepower. The bid for a corresponding steam plant was $74 per horsepower complete. In the case of the plant under consideration the cost per horsepower comes to $95. There is therefore a difference of $22 per horsepower for the by-product feature of the power plant, which seems more than ample, Using the above figures we find the total cost of the producer gas power plant with by-product recovery would be $1,425,000.

Power Cost for Proposed Plant.

In order to determine intelligently whether the entire electro-metallurgical undertaking might prove a good business investment, we should determine in advance the operating costs and all those outlays which enter into the yearly expense of the power plant. This is necessary, because if power can not be obtained at a low cost it will be impossible to produce pig iron in competition with the blast furnace; we will therefore endeavor in the following paragraphs to arrive at the cost per horsepower year at the electric furnace.

The cost of operating the entire power plant is made up of salaries and wages, the cost of fuel, water, lubricants, repairs on the entire equipment

and the fixed charges. This last mentioned item is made up of the interest on the investment, of depreciation and maintenance expenses on the equipment, of taxes and insurance.

The fixed charges have been taken at 15 per cent or $214,000; this is a high figure but the writer thinks that in the face of the constant improvements taking place in power machinery, allowance should be made for such improvement so that at the proper time old or obsolete equipment can be replaced by new.

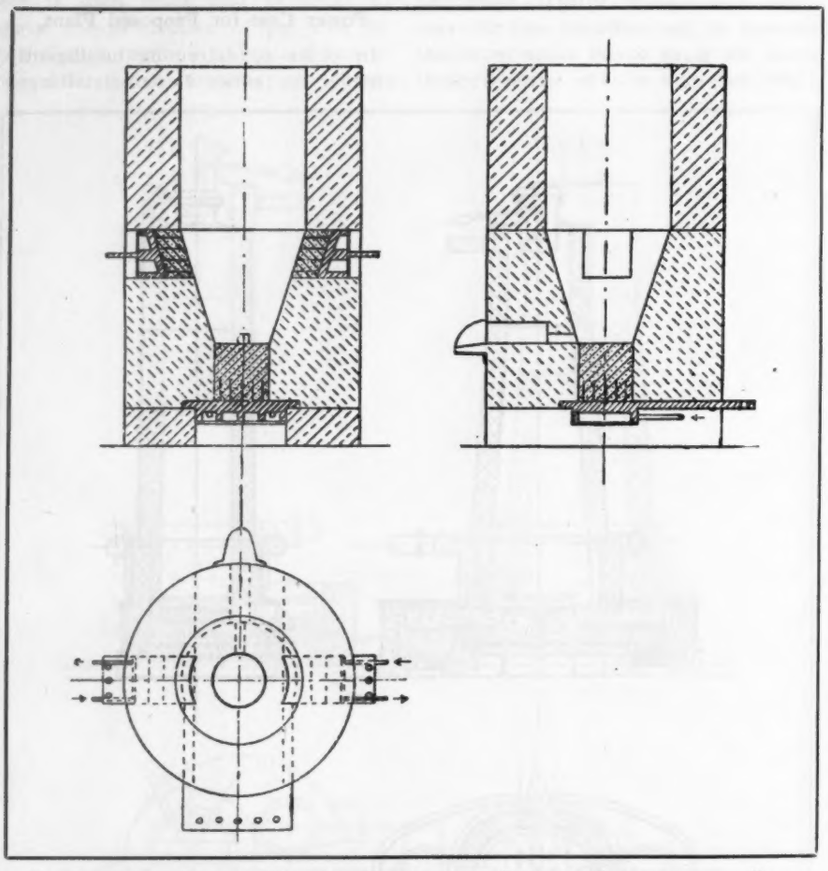


FIG. 5—THIRD TYPE OF FURNACE USED IN THE SWEDISH EXPERIMENTS. THIS FURNACE HAD ONE GRAPHITE ELECTRODE IN BOTTOM AND TWO OTHERS, OPPOSITE EACH OTHER, IN THE SIDES OF THE FURNACE, AS SHOWN.

In an investigation somewhat similar to the one under discussion* the writer took 16 gallons of water per horsepower hour as the quantity required to render the blast furnace gas considered in that investigation fit for the engine cylinders. The author has only meager data at hand on the quantity of water actually used in producer power plants fitted with by-product recovery, but from a careful study of this item he concludes that 16 gallons per horsepower hour would be sufficient for all needs. With the cost of pumping taken at 1 cent per 1,000 gallons (the plant having its own pumping station) the total cost for water would be $15,750 per annum.

The cost of oil, grease, waste, etc., at 2½c per horsepower hour would come to $24,600.

The outlay for salaries and wages per annum would be as follows:

One Superintendent for entire producer plant	$4,000.00
One Assistant superintendent	2,500.00
Four Engineers for each turn at 25c per hour	8,750.00
Four Helpers for each turn at 20c per hour	7,000.00
One Dynamo tender for each turn at 20c per hour	1,750.00
One Switchboard tender for each turn at 17½c per hour	1,500.00
One man for each turn to clean, make small repairs and other miscellaneous work	1,350.00
Total per annum	$26,850.00

Small repairs are taken care of by the fund provided under "fixed charges". However, a separate fund should be set aside to cover such repairs as can not be properly included under the fixed charges. It seems advisable to set aside such a fund to cover possible expenses which would no doubt have to be met occasionally, and which may be due to unskillful and careless handling of machinery, unforeseen accidents, etc. This annual fund has been taken at $25,000.

In this calculation we will assume that the horsepower hour at the furnace will be generated on 1.5 pounds of coal. This amount of fuel includes that required for generating the necessary steam for the producers, the sulphate recovery and the evaporation plant. Slack and the cheaper grades of coal will be used in the producers and, owing to the fact that the freight charges and all intermediate handling of the fuel is eliminated by reason of the location of the power plant at the mine, the price of coal has been taken at 65 cents per ton. The annual charge for fuel would therefore be $42,850.

For wages at the producers, boilers, ammonia plant, and for handling the ammonia in shipping, $29,200 per annum has been allowed. It is claimed by manufacturers of apparatus for by-product-recovery in gas producer installations that a considerably smaller figure will cover this item; in order, however, to be on the side of safety as far as expenditure of money goes the above figure has been allowed.

For sulphuric acid, lubricants, light, repairs, including wages and material for repairs on the producers and the ammonia recovery plant, $28,500 has been computed. This figure, like the one in the preceding paragraph, is on the side of safety and will cover such incidental items as may not be mentioned specifically in the enumeration of the details.

From the operation of the producer plant there would result as by-product 2,210 tons of sulphate of ammonia, which would have a value of $147,800.

For the purpose of clearness all the figures entering into the cost of the horsepower year are re-capitulated in Table I.

TABLE I.—SLIDE RULE COMPUTATIONS.
RESUME OF THE DIFFERENT ITEMS ENTERING INTO THE COST OF THE H. P. YEAR AT ELECTRIC SMELTING FURNACE.

Fixed charges on entire producer power plant	$214,000.00
Water	15,750.00
Oil, grease, waste, etc	24,600.00
Wages and salaries in engine house	26,850.00
Repairs	25,000.00
Fuel	42,850.00
Wages at producers, boilers, ammonia plant, handling and shipping of ammonia	29,200.00
Sulphuric acid, lubricants, light, wages and materials for repairs at producers and ammonia plant	28,500.00
	$406,750.00
Sulphate of ammonia	147,800.00
Total remaining costs	$258,950.00
Cost per horsepower year at electric furnace	24.65

The cost per electric horsepower

*See THE IRON TRADE REVIEW, Jan. 7, 1909.

year at the furnace is very low. It is much lower than one could hope to realize in a gas producer power plant without by-product recovery. Whether the cost of power is low enough to make competition between the blast furnace and the electric furnace possible, is, however, another question. If the production of pig iron in the electric furnace is to be a commercial success it must be possible to produce same in competition with the existing blast furnace methods; we will therefore proceed to investigate if such competition would be possible with the cost of power as found in Table I.

Cost of Power for Electric Smelting Plant.

When compared with our present blast furnace method the main saving resulting in the smelting of iron ores electrically consists in the reduced coke consumption. The average coke consumption in the electric furnace is about 750 pounds coke per ton of iron made. When we consider the consumption of the electrodes the saving will be 0.7 ton of coke per ton of pig iron produced when compared with the blast furnace. If we now assume the cost per ton of coke to be A, 0.7 A will represent the saving per ton of iron produced in the electric furnace as compared with the coke needed in the blast furnace for the production of the same quantity of iron. This saving must be set against any extra expenditure occurring in the production per ton of pig iron in the electric furnace and this extra expenditure is that quantity of electric energy needed to complete the smelting. If we let the cost per electrical horsepower year equal X and if with one horsepower year we produce B tons of iron in the electric furnace then $\frac{X}{B}$ would equal the extra expenditure permissible per ton of iron in order to make the cost of production in the two types of furnaces the same. We have then for the conditions given above the relations as expressed in the equation $0.7\ A = \frac{X}{B}$, which transferred gives $0.7\ A\ B = X$. With coke at $4.50 per ton and with a production of 3 tons of iron per horsepower year the cost of power could come to $0.7 \times 4.50 \times 3 = \$9.45$ per horsepower year in order to make competition under the above conditions possible between the electric smelting furnace and the blast furnace. This figure is of course so aburdly low that no engineer would even think of approaching it with any kind of gas engine installation.

Other Features of Possible Saving.

By making use of every possible saving we may be able to cheapen somewhat the cost of power. In the manufacture of producer gas by the method outlined the resulting tar may be saved. The writer is not aware that this is done at the present time at any of the large by-product producer plants in operation but there does not seem to exist a good reason why this should not be possible, provided the resulting tar from the manufacture of producer gas is of a good marketable quality. It might be of course difficult to find a market for the poor yellow tars resulting from the combustion of lignites and inferior coals in the producers.

In the producer tests carried on by the United States Geological survey 15 gallons of tar per ton of coal used in the producers were extracted on an average by the mechanical tar extractors employed in these tests. When coke is manufactured in by-product recovery ovens the tar forms an im-

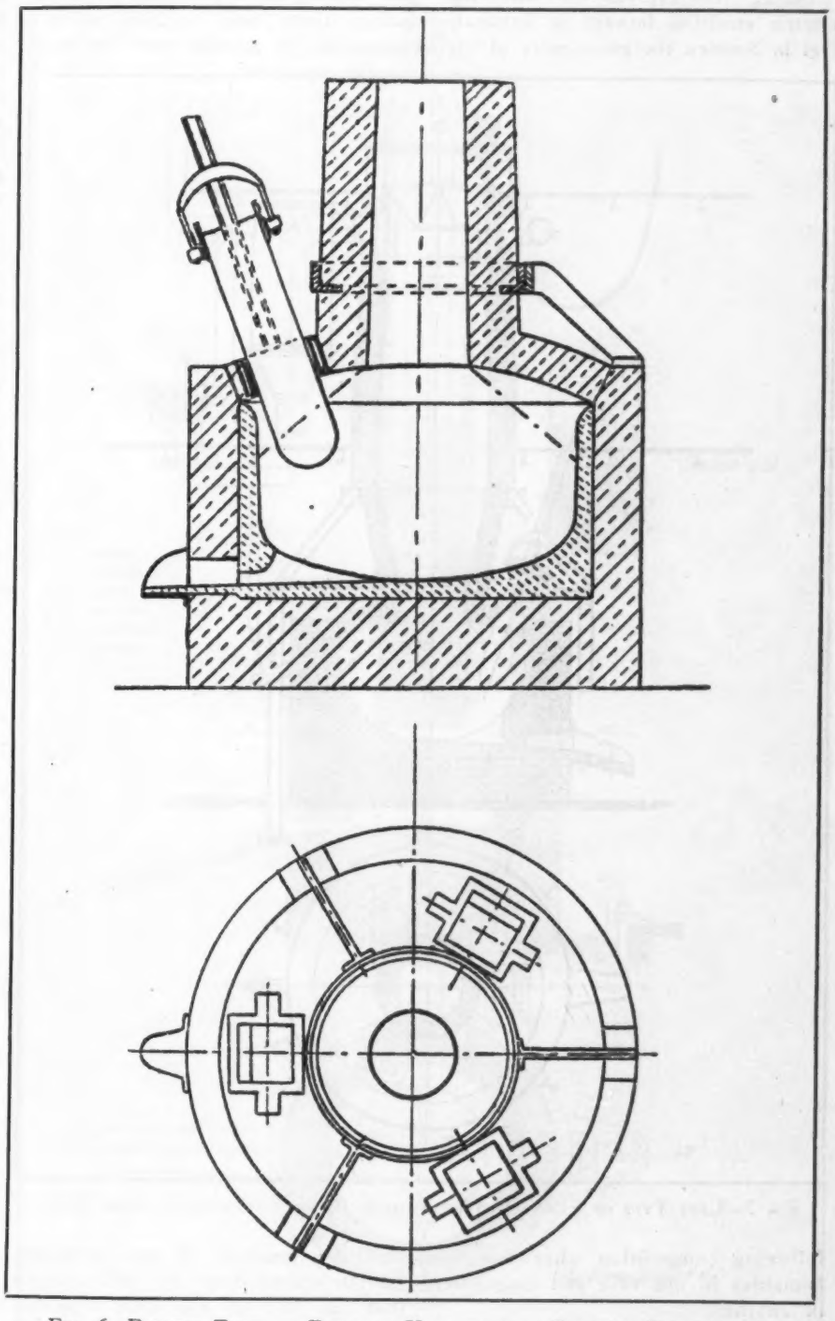


FIG. 6—FOURTH TYPE OF FURNACE USED IN THE SWEDISH EXPERIMENTS.

portant part of the revenues. In this industry the tar is obtained by condensation and collection in large tanks. If we take the value per gallon of tar at 2 cents after deducting all those expenses incurred in its manufacture and sale, this by-product would bring $20,900.

During the experiments with the electric smelting furnace at Domnarfvet in Sweden the gases were of the following composition when smelting hematites in one case and magnetites in another.

	Hematite. Per cent.	Magnetites. Per cent.
$C O_2$	40	25
C O	50	65
H	10	10

In order that the waste gases might be used economically and also to protect the fuel used in smelting from premature combustion, the top of the shaft furnace at Domnarfvet was fitted with an iron cover, a charging bell and hopper.

The heating value of the above gases would be in the neighborhood of 200 British thermal units per cubic foot. Catani gives for the production of one ton of pig iron in the electric smelting furnace 30,600 cubic feet of gas. During the experiments at Domnarfvet there was, to the writer's knowledge, no attempt made to measure the quantity of gas produced. In our calculations we will assume that one half of the total available waste gases can be used to best advantage in a shaft furnace with a high shaft to aid in the reduction of the ores. Further, since Catani's figures for the total waste gases produced have not been questioned, and further, since the figures of other investigators coincide very closely with his figures, they have been taken herein as correct. In the production of 4.16 tons of pig iron per hour (100 tons per 24 hours) there would therefore be available for power purposes on an average 63,750 cubic feet of gas, and after deducting 5 per cent for unavoidable losses this would leave about 60,500 cubic feet, which would be the equivalent of 1,000 electrical horsepower. For the plant in question about 200 horsepower would be required for gas cleaning machinery, hoists, pumps, lights and similar small miscellaneous requirements. The net available power from the waste gases of an electric smelting plant of the size mentioned would then be about 800 horsepower.

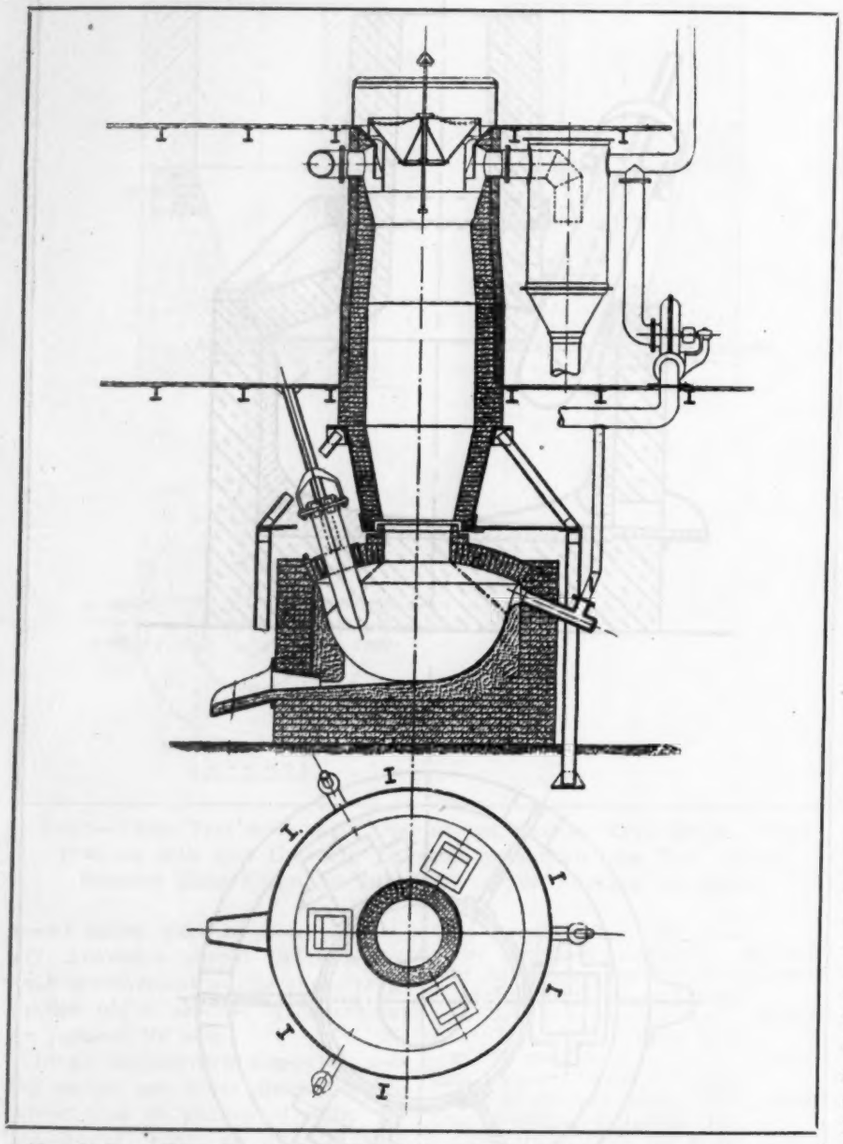


FIG. 7—LAST TYPE OF FURNACE WITH WHICH FINAL EXPERIMENTS WERE MADE.

If we figure the cost per horsepower year at $21 when the waste gases from the electric furnace are used and if we further take into consideration the revenue realized from the sale of the tar, the possibility of which has been pointed out, the horsepower year could be brought down to about $22.50. This would represent the highest point of efficiency in a gas producer power plant with by-product recovery which it might be possible to reach at times, though it is not likely that in continuous runs this high efficiency would be maintained.

At a furnace plant of the size mentioned there are also needed about 30 tons of coke per 24 hours. Theoretically it would seem that a gain would result if this electro-metallurgical plant manufactured its own coke and made use of the resulting by-products, but in practice this would not be feasible. The quantity of coke required from a coke oven plant which supplies an electro-metallurgical plant of the capacity given would be so small that the economical operation of the plant would not be possible. Such a coke oven plant should be located near the producer power plant so that the surplus coke oven gas could be used in the gas engines. This would, of course be possible if the mine itself were producing a coal suitable for a good metallurgical coke. But in the majority of cases the mine would produce a fuel too inferior for such a purpose and in such an event it would be necessary to ship coking coal to the coke oven plant and the coke in turn to the smelting department of the works. All this would render the manufacture of coke at the electro-metallurgical plant unprofitable; by-product recovery on such a small scale would likewise prove impractical.

Up to this point we have shown that in the best and most efficient types of gas producer plants under the

best possible conditions the power could not be produced at a cost low enough to make the operation of an electric iron-smelting enterprise a commercial success. The same inference can be drawn from the various statements of those engineers who have given deep study to this problem.

F. W. Harbord, in a paper read before the West Scotland Iron and Steel Institute, has this to say:

From a British standpoint the direct smelter of iron ores in the electric furnace is of little practical importance, as, although considerable advances have been made and are being made, the conditions existing in our country are such that the electric furnace can not compete with the blast furnace. In countries which have no suitable fuel for blast furnace work, but have large ore deposits and cheap water power, such as Canada and countries similarly situated, the position of direct smelting is different, and the gradual developments are being watched with the greatest interest. Since the experiments made in the Keller furnaces at Livet by the Canadian commission demonstrated that all grades of pig iron could be produced at quite a reasonable cost various experiments have been carried out in different countries and much useful information has been obtained.

In 1906 the Canadian government voted $15,000 for experiments in electric smelting. These experiments were carried out under the supervision of Dr. Haanel at Sault Ste. Marie, Ont., and full details have been published in a special report.* The primary object of the experiments was to determine if the Canadian magnetites and also certain ores existing in large quantities and containing considerable percentages of sulphur, but no manganese, could be smelted to produce pig iron of high quality; also if charcoal and peat coke could be used as the reducing agent. The results showed that magnetites could be produced from high sulphur ores. Both charcoal and peat coke proved satisfactory reducing agents as a substitute for coke, and a pig iron of good quality containing only 0.43 per cent titanium was produced from titaniferous ores containing 17 per cent of oxide of titanium. This last point may have far reaching results on the future development of electric smelting, as not only does it make available all the titaniferous ore sands of the St. Lawrence river, but those of New Zealand and many titaniferous iron ore deposits quite useless for the blast furnace.

Mr. Harbord concludes as follows:

With regard to pig iron, this can be produced of any grade and of satisfactory quality, but the electric furnace can not compete with the blast furnace under the conditions existing in this and other countries, where fuel is cheap, though there is a considerable field for its development in countries where cheap water power is available, and where, owing to suitable blast furnace fuel being unobtainable, and other conditions, it might be possible to produce pig iron commercially, and in the near future, with the gradual improvements in the furnace design which are taking place, we may anticipate that in the countries referred to electric smelting of iron ores will become an established industry. At the same time it can not be too strongly borne in mind that the conditions for the commercial production of pig iron are confined to special cases and no general opinion can be given. Only when all local conditions, both as to the cost of power, raw materials, labor, etc., as well as the class of product required and the market for the material, have been most carefully investigated can a sound opinion be given as to its commercial feasibility.

In this connection it is interesting

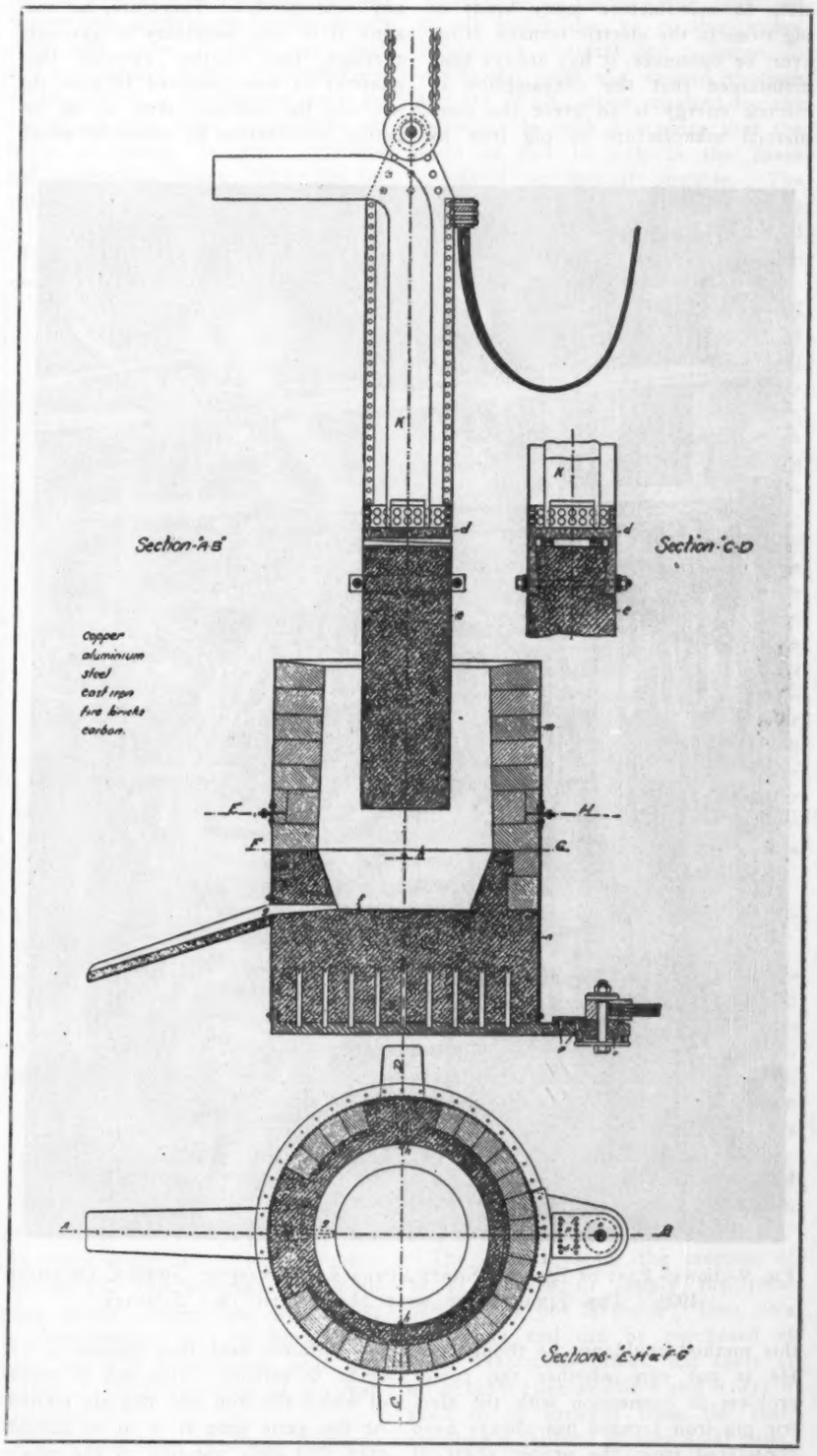


FIG. 8—EXPERIMENTAL FURNACE USED AT SAULT STE. MARIE.

*See, also, THE IRON TRADE REVIEW, Sept. 30, 1909.

to consider the opinion of Prof. F. Richard Eichhoff regarding the power consumption by the electric furnace. He says nobody doubts that from a metallurgical point of view it is possible to manufacture many kinds of pig irons in the electric furnace. However, he continues, it has always been maintained that the consumption of electric energy is so great the commercial manufacture of pig iron by this method could not be thought of. He is not sure whether the power problem in connection with the electric pig iron furnace has always been considered from the proper point of view and he thinks that the oftmentioned consumption of from 2,000 to 2,500 kilowatt hours per ton of pig iron produced is not correct. His claim is that practical experiments have shown already that from 1,400 to 1,500 kilowatt hours are sufficient for the work above mentioned; also that in the reduction of peroxide of iron through carbonic oxide there is as a whole no heat generated nor is there any heat needed. Therefore, he reasons, it is only necessary to generate through the electric current that quantity of heat required to heat the ore and the carbonic oxide to the reaction temperature by means of which the carbonic acid thus formed is reduced to carbonic oxide and by means of which the iron and slag are melted. At the same time it is to be considered that only one-half of the newly generated carbonic oxide formed from the carbonic acid by the addition of carbon is needed for the further reduction of iron and that the other half may be used for the generation of heat for either of two purposes, viz., to heat the carbon needed for the re-combination of carbonic acid. If this view is taken and if we assume that an electric furnace, like a blast furnace, may operate with an efficiency of 70 per cent Prof. Eichhoff feels convinced that in a not very distant future it will be possible to produce a ton of iron with 770 pounds of coke (this is being done already) and a power consumption of about 1,000 kilowatt hours.

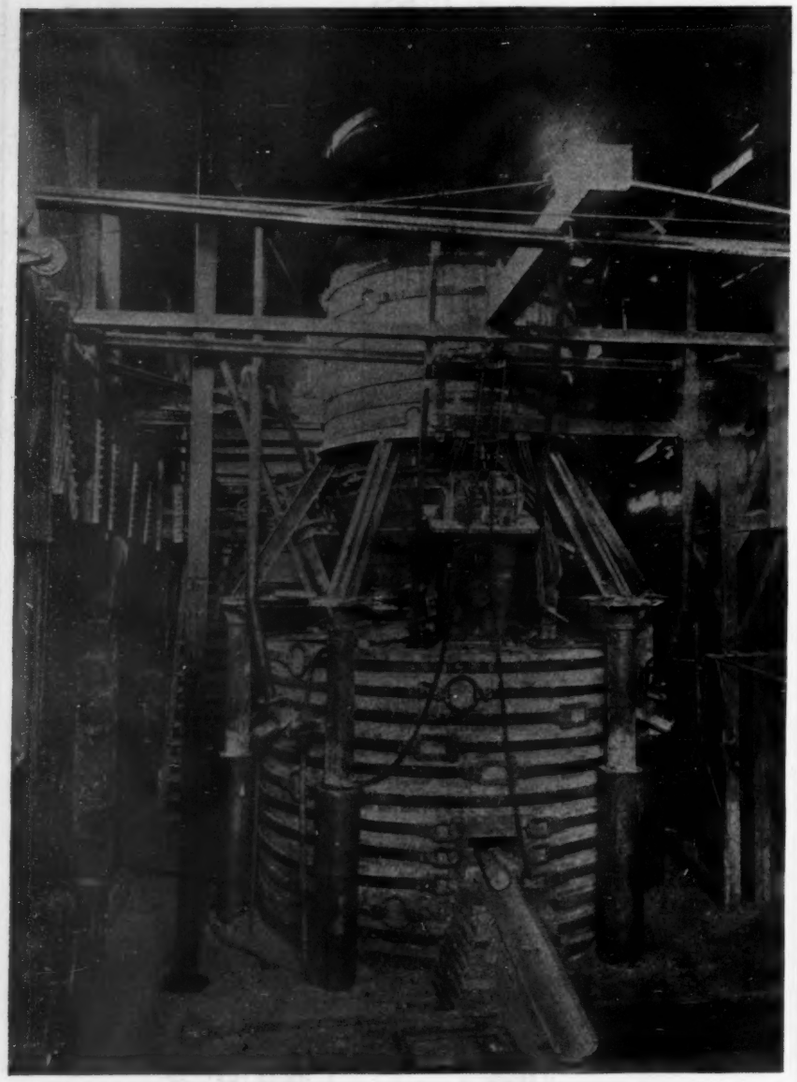


FIG. 9—LOWER PART OF ELECTRIC SHAFT FURNACE, DOMNARFVET, SWEDEN, DECEMBER, 1908. THE FINAL RUNS WERE MADE WITH THIS FURNACE.

Prof. Eichhoff gives then some figures on the cost of coke and electricity in Germany which have no bearing on our problem at hand and are therefore not repeated. He further says that if, in the not too distant future, it becomes necessary to use leaner ores we will have then no doubt more concentrated ores than we have now; further, should the cost of coke increase, which is not at all impossible, and if in addition it should happen that we can use at present undeveloped water power, peat bogs and similarly untouched power resources, the possibility of producing pig iron in the electric furnace approaches closer and closer. When that time has once arrived it will not be the custom then to produce pig iron such as is produced today, but a pig iron with 1½ to 2 per cent carbon, which may then be converted into steel in large electric furnaces with an expenditure of from 100 to 150 kilowatt hours only per ton of steel produced.

If it should become possible to produce iron in the electric furnace with a power expenditure of 1,000 kilowatt hours per ton only, then the cost per horsepower year could come to $0.7 \times 4.50 \times 6.25$, or $19.65, with coke at $4.50, and thus make possible competition between the electric smelting furnace and the blast furnace. This figure comes close to the lowest figure found for the producer gas power installation considered. However, up to the present time we do not seem to have reached the point of efficiency where a ton of iron can be produced by the expenditure of a 1,000 kilowatt hours only. During the experiments made at Domnarfvet, Sweden, as reported by Director Lars Yngstrom, the average power consumption per ton of iron produced was 3,181 kilowatt hours. Such a power consumption would mean that the cost per horsepower year should not be more than $0.7 \times 4.50 \times 1.97$ or $6.20 if coke costs $4.50 per ton.

As has already been stated 3,181 kilowatt hours per ton of iron is not by any means the best attainable power consumption. In the coming years

great progress no doubt will be made if furnaces are constructed in such a manner that the correct principles can be carried out. The writer has seen nowhere a more concise statement of the fundamental principles of the reduction of iron ores in the electric furnace than in the writings of Prof. Richards and the liberty is taken therefore to quote from him; in connection with his exposition he shows two charts which illustrate the fundamental principles and which are reproduced in Fig. 1 and Fig. 2. He states that the reduction of iron ores in the electric furnace is entirely dependent upon the rate at which the furnace is run and the proportion of CO to CO_2 in the gases.* In the latter respect a proportion of 1 to 1 by volume is entirely practicable and should be attained in electric smelting, although 2 to 1 is the usual ratio in blast furnace practice. A kilogram of oxygen burning carbon to CO gives up 1,820 heat units (calories), but if burning (only half as much) carbon to CO_2 it gives up 3,075 calories. Since there is a definite amount of oxygen to be removed per ton of pig iron made, more assistance is obtained from the combination of carbon and oxygen the more CO_2 and the less CO is formed. Fig. 1 shows the heat evolved in units of 1,000 calories, as the ratio of CO to CO_2 varies from all CO to ratios of CO to CO_2 equal 3, 2 and 1, extended to the supposed case of all CO_2 being found. It shows graphically the fact that the smaller the amount of carbon used the more heat is obtained from its oxidation, because it is being burnt by a fixed quantity of oxygen.

Experiments made on the reduction of iron oxides in currents of CO_2 gas render it improbable that a lower ratio of CO to CO_2 equal —1 can be obtained in practice even under the most favorable electric furnace conditions. This corresponds to 0.26 tons of carbon per ton of iron made and a thermal assistance of 1,111,500 calories (1,750 horsepower hours) per ton of iron.

Fig. 2 shows the variation of horsepower required per ton of pig iron with the ratios of CO to CO_2 in the gases. It shows distinctly how wasteful of power it is to run a furnace with too much carbon; with a certain amount of carbon charged it is practically impossible to utilize it except it burns mostly to CO and then the higher power consumption is the result of the lack of proper thermal assistance from the carbon.

*See, also, IRON TRADE REVIEW, May 13, 1909.

The power curve of the Swedish furnace is above that of the Sault Ste Marie runs for the same fuel consumption or ratio of CO to CO_2, because the former furnace was being run at not over one-fourth, possibly nearer one sixth of its proper supply while the latter furnace was small and was pushed hard. The difference of the 0.1 of a horsepower year per ton of pig iron made is probably entirely ascribable to high radiation and conduction losses, due to the relatively slow running.

In conclusion Prof. Richards says "if a large electric furnace is run rapidly with abundant power and the gas escaping contains at least as much CO_2 as CO (by volume), the minimum power requirement which will be approximated is 1,580 horsepower hours or 0.18 horsepower year per metric ton (2,204 pounds) of pig iron produced."

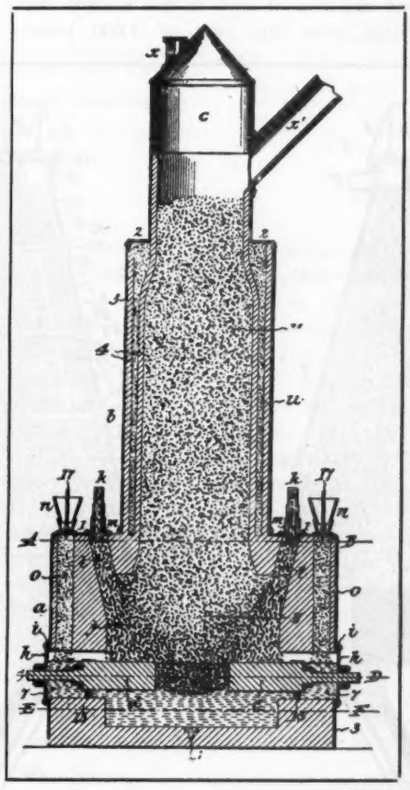


FIG. 10—THE TAYLOR ELECTRIC FURNACE FOR PRODUCTION OF CARBON BI-SULPHIDE.

(For details see THE IRON TRADE REVIEW, Jan. 13, 1910.)

The conclusions of Prof. Richards regarding the possible power consumption in the electric furnace agree, therefore, very closely with those of Prof. Eichhoff. The figures for coke consumption obtained by the Swedish investigators are as near the theoretical evidently as it is possible to obtain them. The only saving then by means of which we may be able to attain the greatest economy and towards which we will have to strive is realized, first, through the reduction of all losses due to cooling water, conductors, contacts and radiation, to the lowest point and, second, through the use of all carbon required for the reduction in such a manner that the ratio of CO to CO_2 in the gases equals 1 or less if possible. The nearer we can come in practice to the above two items the nearer we will approach the low limits of power requirement as given in this paper.

From the conditions thus imposed it is not likely that the production of pig iron in the electric furnace will displace the blast furnace in the eastern United States, nor in the Ohio, Chicago and southern districts, in fact in any district where conditions and costs of coke, ores, transportation, etc. are as in the districts mentioned. In none of these districts is the cost of coke at the furnaces more than $4.50; in the majority of cases the cost of coke is less. We have also seen that with the best possible furnace operation and with coke at $4.50 per ton it would have to be possible to generate the horsepower year for $19.65 in order to establish competition. But with the best imaginable conditions for the producer gas power plant it would be impossible in these districts to generate a horsepower year for less than $22.50.

Strategic Position of Electric Smelting on the Pacific Coast.

For other localities than those referred to in the preceding paragraph the conditions become of course different; take the case of the states on the Pacific coast. In the state of California for instance the consumption of pig iron is estimated at 150 tons daily. The price fluctuates usually between $24 and $27.50 per ton and from $9 to $10.50 per ton higher than in Pittsburg.

The conditions for the erection of blast furnaces to supply the local demand are not favorable. Iron ores are found and can be purchased at fairly reasonable prices, but there is no suitable coke available and it would need to be brought from the east, entailing a railhaul of over 3,000 miles. Imported coke costs from $10.50 to $14 per ton and in addition the supply is irregular.

Since the amount of coke required in electric smelting is only about three-tenths of the amount needed for

the blast furnace and since in many places of California, ores, limestone and electric power may be had cheaply, the conditions there for manufacturing pig iron by electric smelting are very favorable in spite of the high price of coke. In Shasta county, California, a self-fluxing iron ore of about the following analysis can be mined at reasonable cost:

	Per cent.
Iron	69.90
Magnesia	0.10
Manganese	0.18
Silica	2.40
Phosphorus	0.011
Sulphur	0.009

The limestone occurring with the ores is reported to be likewise of a quality suitable for the electric smelting furnace. Even if cheap hydraulic power were not available there might be still sufficient fuels found in this state to generate the power in gas producer power plants. These coals are not suitable for use in by-product recovery plants on account of their small content of nitrogen, but nevertheless it should be possible to produce the horsepower year for $28. Even if California coal fields are few and far between, it would be possible to generate power in the coal fields of southwestern Utah and transmit it across Nevada into California. With a price of $30 per horsepower year at the furnaces it should be possible to produce pig iron in the electric smelting furnace in that state for $21 per ton, if freight on the eastern ores and the profit to the eastern pig iron manufacturer are not considered. This figure in the absence of other accurate data is an approximation only and has been arrived at by deducting from the Pittsburg market price of pig iron the eastern cost of coke required for smelting in the blast furnace and adding the California cost of coke required for the production of one ton of iron in the electric furnace, plus the cost of 1,600 horsepower hours if the horsepower year costs $30 at the smelting works. In the preceding calculations the market price of pig iron in the Pittsburg district is taken at $16. By selling the iron produced in the electric furnace at the market price existing in California there would be realized a net profit of at least $4 to $6 per ton. However, if the approximate cost of production of electric furnace iron is desired it is necessary to deduct from the cost already found the average profit which the eastern manufacturer makes on his product. This deduction must be made if we work on the assumption that any difference in the cost of producing pig iron by the two methods is based on the coke and power requirements only; due consideration must of course be given to the market price of these commodities in the two localities concerned. We will estimate the average net profit of the pig iron manufacturer at $2 per ton. This figure has been decided upon after examining the published reports of the bureau of corporations; no doubt the average net profit fluctuates somewhat, but figure chosen is considered a fair average estimate.

Since the ore used in the Pittsburg district is brought perhaps without exception from the northern lakes and since an electric smelting plant in California would no doubt be located near the ore deposits, the expense incurred in transporting the ores would be eliminated in the case of the electric furnaces on the Pacific coast. The writer has no accurate data on the present cost of handling and transporting ores to Pittsburg district furnaces, but he has concluded that the cost can not be less than $3 per ton of iron produced. For the sake of

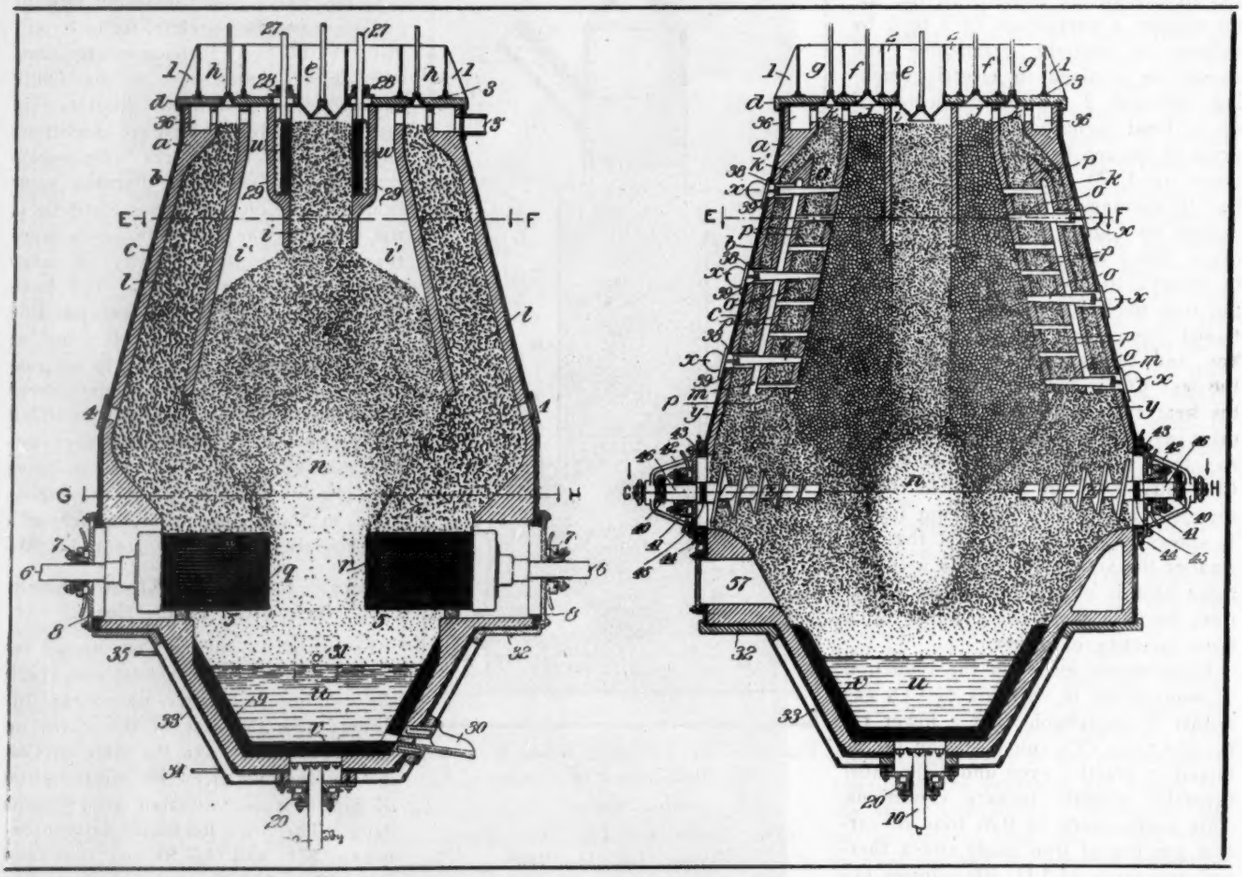


FIG. 11—SECTIONS OF MODIFIED TAYLOR FURNACE PROPOSED FOR ELECTRIC REDUCTION OF IRON ORE.

clearness a resume is given in Table II of the figures entering into the cost of electric furnace pig iron.

Assumed market price of pig iron in Pittsburg district, $16. Cost of producing one ton of iron in electric furnace under given conditions on Pacific coast is therefore

$16 — $7.90 + $8.85 = $16.95.

The preceding figure is based on the minimum power consumption of 1,600 horsepower hours per ton of iron produced. However, it is not likely that with our present experience a ton of pig iron could be produced with the minimum of 1,600 horsepower hours; 2,500 horsepower hours might perhaps be considered an attainable average figure in the present state of development. In Table III we present the probable economical results which may be expected under the given conditions from the operation of an electric smelting works if located near the Shasta iron ore deposits in California. The cost of five electric furnaces complete with crushing machinery, all necessary tools, ladle equipment, tracks, laboratory, offices, etc., would be about $500,000. The grand total for the entire smelting plant inclusive of producer gas power plant would be therefore about $1,925,000.

TABLE II.—SLIDE RULE COMPUTATIONS.

	Blast Furnace.	Electric Furnace.
Coke to produce one ton of blast furnace pig iron in Pittsburg district	$2.90	....
Coke to produce one ton of electric furnace pig iron near California iron mines	....	$3.15
Power required for smelting in electric furnace if the horsepower year costs $30	....	5.70
Assumed net profit in production of one ton of pig iron in Pittsburg district	2.00	....
Cost of handling ores from mines to blast furnaces	3.00	....
Totals	$7.90	$8.85

From Table III it is evident that a producer gas power plant furnishing the horsepower year at $30 would not make possible large economic returns, While a return of 12.5 per cent would in most cases be satisfactory for instance in real estate, it is not at all satisfactory in the case of an industrial enterprise. Capitalists would want a much greater return on an investment in an industry which is subject at times to severe fluctuations.

Items I in Table III have been computed in the manner already given.

Items 2 are the differences between the price of pig iron in the California market and Items 1 multiplied of course by the annual tonnage.

The fixed charges in Items 3 have been taken for the smelting plant only, since this item for the power plant is already included in the cost of power per horsepower year.

Items 4 are self evident.

Items 5, or the annual profit on Investment in per cent with the gas power installation, is item 4 divided by the total cost of the plant or $1,925,000 plus 6 per cent interest figured in the fixed charges.

It will be noticed that Item 5, under heading "Hydraulic Power," in Table III is much greater than Item 5 under the heading "Producer Gas Power Plant." This large difference in the earnings is not due to the lesser cost of power alone. By far the greater part of this difference must be accounted for through the fact that the hydraulic power installation is conceived as a separate business proposition yielding a substantial profit from the sale of power at $18 per horsepower year. The writer feels satisfied that the hydraulic power installation should be so conceived since he believes that there are many hydro-electric power companies operating who are willing continually to sell power at that price to large and steady consumers. Item 5 under "Hydraulic Power" in Table III has therefore been obtained by dividing Item 4 by $500,000, the estimated cost of the smelting plant proper, and adding thereto the 6 per cent interest allowed on the fixed charges. From Table III it is therefore evident why all those who have given any considerable study to this question have always come to the conclusion that the smelting of iron ores in electric furnaces will yield the greatest commercial return when hydro-electric power can be purchased at a reasonable price from a water power development company. For in such a case not only is the horsepower year cheaper as a rule than in a producer gas power plant, but the interest on the investment in the gas power installation, which investment is nearly three times that of the smelting plant proper, falls away in the case of the hydraulic installation; therefore the interest which would have to be counted in the fixed charges of a producer gas power plant may, in the case of hydraulic power, be applied to the net profit account of the business.

The possibility of such an industry in California has been realized by the Shasta Iron Co. in its experimenting with Heroult furnaces. However, the writer has seen no data regarding the economic operation of the plant nor whether at the present time the undertaking can be called a commercial success.

Electric Smelting Plant in the Iron Regions of the Northern Lakes.

While working out the preceding data the question of how the financial side of an electric furnace undertaking would appear if located near the great iron ore deposits in Minnesota, Wisconsin and northern Michigan, suggested itself. The ore supply of the iron producing districts of Chicago, Ohio, Pittsburg and part of the eastern district, is drawn from these fields. It appears that it might be possible to obtain hydro-electric power at reasonable costs in these northern states. As an alternative there would be the coal deposits in the central portion of Iowa, in the northern part of Illinois and in the northern interior coal fields of Michigan. These coal fields are within a distance of from 150 to 400 miles of the iron mines mentioned above and, if from a commercial standpoint the project is otherwise practical, these distances are within our present limits of power transmission. In Table IV we have given the different items necessary to determine the probable cost of pro-

TABLE III.—SLIDE RULE COMPUTATIONS.

Pacific coast.	Power requirement for the production of one ton of pig iron with 2,500 horsepower hours.	1,600 horsepower hours
Producer gas power plant without by-product recovery.		
1. Production cost of pig iron when power costs $30 per horsepower year	$ 20.25	$ 16.95
2. Profit when market price of pig iron is $26 and the annual production is 35,000 tons	201,300.00	316,600.00
3. Fixed charges on smelting plant proper	75,000.00	75,000.00
4. Probable annual profit after deducting fixed charges	126,300.00	241,600.00
5. Annual profit on investment, per cent	12.56	18.50
Hydraulic power.		
1. Production cost of pig iron when power costs $18 per horsepower year	16.65	14.67
2. Profit when market price of pig iron is $26 and the annual production is 35,000 tons	330,400.00	397,000.00
3. Fixed charges taken at 15 per cent on smelting plant proper.	75,000.00	75,000.00
4. Probable annual profit after deducting fixed charges	255,400.00	322,000.00
5. Annual profit on investment, per cent	51.00	64.45

duction of pig iron in the electric furnace near the ore mines referred to if 1,600 horsepower hours only were required per ton of iron. The method employed of arriving at the cost of production in this case is the same as that in the case of producing electric furnace iron on the Pacific coast.

Market price of pig iron in Pittsburg district, $16. Probable production costs of pig iron per ton near northern lake mines, therefore, $16 — $7.90 + $7.20 = $15.30.

It should be remembered here that $15.30 is the production cost of electric furnace pig iron in the localities referred to, while $16 is the assumed selling price in the Pittsburg district.

TABLE IV.—SLIDE RULE COMPUTATIONS.

	Blast furnace.	Electric furnace.
Coke to produce one ton of blast furnace pig iron in Pittsburg district.	$2.90	....
Coke to produce one ton of electric furnace pig iron near northern lake mines	....	$1.50
Power required for smelting in electric furnace if the horsepower year costs $30	....	5.70
Assumed net profit in production of one ton of pig iron in Pittsburg district	2.00	....
Cost of handling ores from mines to blast furnaces in Pittsburg district per ton of pig iron	3.00	....
Totals	$7.90	$7.20

In order to obtain a clear view of the economic possibilities of an electric smelting plant in the regions named, Table V has been worked up. The explanations pertaining to Table III apply also to Table V.

Table V shows that the return on the investment, even with the least power consumption, is so small that it would be difficult to induce capital to engage in this enterprise under the given conditions. If electric smelting is to be a commercial success the conditions must be practically like those for the state of California, viz., cheap and rich ores, cheap hydraulic power and such natural conditions as will always bring relatively high selling prices for the pig iron produced in the vicinity of the smelting plant.

First Cost of Blast Furnace and Electric Smelting Plants Compared.

Another point to be seriously considered in the establishment of an electro-metallurgical works is the first cost of the plant. Wherever hydro-electric power can be purchased at a reasonable price its use will be of advantage, since, as already stated, the generation of hydro-electric power would be considered a business enterprise separate and distinct from the smelting plant proper. If a producer gas power plant were to be installed in a locality like California we would need a plant of 15,000 horsepower capacity. The total cost of such a power plant and smelting works complete would be $1,925,000. If we compare this figure with the construction costs of a modern blast furnace and if we consider the daily outputs of these two types of plants the sum mentioned seems very large. For a million-dollar blast furnace plant in this country we may count on an average daily production of 400 tons. On this basis of cost and tonnage the blast furnace method of producing iron would require per ton of iron about 13 per cent of the initial expenditure required for the electric smelting furnace. This is, of course, no argument against the electric installation, for the high cost of any undertaking need not necessarily be an argument against that undertaking. The main question to be considered is whether it will pay, and what percentage on the investment.

Probable Success of Electric Smelting Plants in Pittsburg and Chicago Districts.

In Table VI are given figures indicating the probable commercial success which an electric smelting plant would have in the Pittsburg district. These figures are given for the benefit of those who think that there should be a possibility of making an electric smelting industry a success in this district, because here both an excellent coal, suitable for by-product recovery in the gas producers, is mined, and metallurgical coke is cheaper than in any other blast furnace district in the United States. The figures have been worked out for an installation deriving its electric power from a by-product gas producer station only, since no water power developments of any consequence seem possible. The cost of handling the iron ores from the mines to the Pittsburg district is considered the same for both the blast furnace and the electric furnace plant.

From Table VI it appears that under the given conditions and with the probable power consumption of 2,500 horsepower hours an electric smelting plant of the capacity given would operate with a loss of about 2.62 per cent on the entire investment of $1,925,000.

For the Chicago district the conditions would again be somewhat different owing to the fact that different figures come into play for coke, freight, price of iron, etc. A summary of the probable conditions is given in Table VII.

In working up Table VII there has been allowed $1.50 for handling the ores from the iron ranges to the electric smelting furnace located in the Chicago district. It should perhaps be further explained here that the apparent inconsistency in Table VII in items 4 and 5 is not real. Item 4 shows an annual loss of $27,800, while item 5 shows an annual profit of 4.56 per cent on the investment. The 4.56 per cent represents the 6 per cent interest in the fixed charges of the entire installation minus the loss as given in item 4 divided by the total cost of the entire plant, or

$$\frac{115{,}500 - 27{,}800}{1{,}925{,}000} = 4.56 \text{ per cent.}$$

Conclusion.

In this paper it has been shown that the chief requirement for the successful commercial operation of an electro-metallurgical plant for the production of pig iron is cheap power and that under the best possible arrangements the gas producer power plant could not

TABLE V.—SLIDE RULE COMPUTATIONS.

Northern lake mines.	Power requirement for the production of one ton of pig iron with 2,500 horsepower hours.	1,600 horsepower hours.
Producer gas power plant without by-product recovery.		
1. Production cost of pig iron when power costs $30 per horsepower year	$ 18.60	$ 15.30
2. Profit when market price of pig iron is $18 in Chicago market and the annual production is 35,000 tons	*21,000.00	94,000.00
3. Fixed charges on smelting plant proper	75,000.00	75,000.00
4. Probable annual profit after deducting fixed charges	*96,000.00	19,000.00
5. Annual profit on investment in per cent	1.01	6.98
Hydraulic power.		
1. Production costs of pig iron when power costs $20 per horsepower year	15.60	13.40
2. Profit when market price of pig iron is $18 in Chicago market and the annual production is 35,000 tons	84,000.00	161,000.00
3. Fixed charges on smelting plant proper	75,000.00	75,000.00
4. Probable annual profit after deducting fixed charges	9,000.00	86,000.00
5. Annual profit on investment in per cent	7.80	23.20

* = Loss.

under present conditions furnish the horsepower year at a cost low enough to make the electric furnace a serious competitor of the present modern blast furnace. Even if the fuel for the producer plant had no value, in other words, if it were given free, it would still be impossible to produce the power cheaply enough to change materially the cost of the horsepower year. The chief reason for this is found in the fixed charges of the power plant which total a considerable sum.

TABLE VI.—SLIDE RULE COMPUTATIONS.

Pittsburg district. Producer gas power plant with by-product recovery.	Power requirement for the production of one ton of pig iron with 2,500 horsepower hours.	Power requirement for the production of one ton of pig iron with 1,600 horsepower hours.
1. Production cost of pig iron when power costs $22.50 per horsepower year	$ 18.60	$ 16.12
2. Profit when market price of pig iron is $16 in Pittsburg district and the annual production is 35,000 tons	*91,000.00	*4,200.00
3. Fixed charges on the smelting plant proper	75,000.00	75,000.00
4. Probable annual profit after deducting fixed charges	*166,000.00	*79,200.00
5. Annual profit on investment, per cent	*2.62	1.88

* = Loss.

Should it be possible in the future to produce a pig iron in the electric smelting furnace greatly superior to the pig iron produced in the blast furnace, the present conditions would of course be changed. In such an event the electric furnace iron would be able to command a better price than blast furnace iron. At the present time, however, electric furnace iron has not shown in the testing machine any marked features of superiority over blast furnace iron.

There may, however, at some future time arise a number of conditions the combination of which may tend to put the electric furnace for pig iron production on a firm basis and enable it to compete with the blast furnace. One of these conditions may be a possible growing scarcity of first class blast furnace coke, with the consequent tendency to higher prices for it and the resulting higher market value of pig iron. Another condition may be the high probability of improvements being made in the electric furnace with the certainty of bringing the power consumption near the ideal power consumption; a third condition might be the probability of producing a pig iron low in carbon, thus making it more suitable than blast furnace pig iron for the manufacture of steel.

Different types of smelting furnaces that may be invented in the future will not be able to produce the ton of pig iron on less power than the theoretical minimum which is between 1,500 and 1,600 horsepower hours. The entire electro-metallurgical industry would, however, receive a tremendous impetus if a type of electric furnace should be evolved which would make possible the production of a first class steel from the ores directly with the minimum theoretical power consumption. It has been demonstrated that this can be done and future developments along this line are awaited everywhere with great interest.

TABLE VII.—SLIDE RULE COMPUTATIONS.

Chicago district. Producer gas power plant with by-product recovery.	Power requirement for the production of one ton of pig iron with 2,500 horsepower hours.	Power requirement for the production of one ton of pig iron with 1,600 horsepower hours.
1. Production cost of pig iron when power costs $22.50 per horsepower year	$ 16.65	$ 14.01
2. Profit when market price of pig iron is $18 in Chicago market and the annual production is 35,000 tons	47,200.00	139,800.00
3. Fixed charges on the smelting plant proper	75,000.00	75,000.00
4. Probable annual profit after deducting fixed charges	*27,800.00	64,800.00
5. Annual profit on investment, per cent	4.56	9.37

* = Loss.

Pacific Coast Steel Developments in 1910

At and near San Francisco there is at the present time considerable activity in the line of iron and steel production. In California there are three separate companies constructing plants to engage in the manufacture of some product of the iron and steel business. These companies are, the Columbia Steel Co., San Francisco, which has just put into operation the only open-hearth steel casting plant now operating on the Pacific coast, the Pacific Coast Steel Co., San Francisco, which is completing open-hearth furnaces and a rolling mill at South San Francisco, and the Noble Electric Steel Co., San Francisco, which is now building the only commercial electric blast furnace plant in the world, so far as known, at Redding, Cal.

For a number of years the Noble Electric Steel Co. has been experimenting with the electric smelting of iron ore. At Redding, Cal., where the experimental work has been carried on, the company owns large quantities of raw materials, including limestone carrying 98 per cent of calcium carbonate, a large acreage of timber for the production of charcoal and deposits of iron ore estimated at from 2,000,000 to 10,000,000 tons. This ore is a magnetite carrying from 65 to 70 per cent of iron. With these raw materials it was only necessary to obtain fuel. The fuel problem has been finally solved by the Noble Steel Co. in connection with the Northern California Power Co., of which H. H. Noble is president, by the use of the electric furnace. Starting with a small experimental furnace of two tons, the size has been gradually increased until a commercial size of furnace has been developed with a capacity of 20 tons. For some time past, this furnace has been producing electrically-smelted pig iron, the first of its kind to be produced on the Pacific coast, and the first commercially in the United States.

The furnace used by the Noble Electric Steel Co. is something of an adaptation of the ordinary blast furnace, consisting of two parts, the stack and the melting crucible or hearth. The stack is superimposed on the hearth and at the top of the stack, the ore and the charcoal for its reduction are charged through a rotary bell top. In general the furnace resembles the Swedish shaft furnace described in THE IRON TRADE REVIEW, Aug. 11, 1909. The hearth has a diameter of 10 feet and is equipped with two electrodes. The electric furnace is of the resistance type. It is claimed that by its use pig iron can be produced with a fuel consumption of about one third that required for the same ore in an ordinary blast furnace. As this deposit of ore is located remote from an available fuel supply and the expense of transportation is high, it was impossible to commercially develop it by ordinary methods, but the electric furnace has, it is said, made it possible to produce iron profitably.

The operation of the electric furnace is not unlike the ordinary blast furnace. The gases are taken off near the top of the stack and a part is re-

introduced at a lower point in the stack and burned. The remainder of the gas is passed through a scrubber and thence into the hearth near the electrodes in order to somewhat reduce the intense heat, which has been found to be one of the chief difficulties in the development of the large size furnace.

On the Pacific coast blast furnace development and the production of iron and steel have been greatly hampered by the cost of suitable coke. Nearly all Pacific coast coke contains from 15 to 25 per cent, and upwards, of ash, and a large amount of sulphur. With the amount of coke used in a blast furnace, it is almost impossible to produce a satisfactory pig iron with coke having such a high percentage of ash and sulphur. By using charcoal made in by-product ovens from timber on its properties, the Noble Electric Co. has been able to produce a pig iron with the sulphur and phosphorus not higher than 0.012 per cent. That this electrically-smelted iron is satisfactory was recently demonstrated by the Columbia Steel Co., at Portland, Ore., where the first steel castings ever produced entirely from Pacific coast products, were cast in its foundry.

The Noble Electric Steel Co. is beginning the construction of five 20-ton electric furnaces at Redding, the designs being the result of its past experimental work extending over a period of some four years. S. T. Wellman, formerly president of the Wellman-Seaver-Morgan Co., Cleveland, is consulting engineer for the Noble company.

The second company soon to engage actively in the manufacture of steel in California is the Pacific Coast Steel Co., 402 Sheldon building, San Francisco, which will, about March 1, 1911, have an open-hearth plant and rolling mill in operation in South San Francisco. D. P. Doak, president of the Doak Sheet Steel Co., now has a small sheet mill at the location of the new plant, Mr. Doak also being president of the Pacific Coast Steel Co. The Pacific Coast Steel Co. is building two 25-ton open-hearth, basic, oil-burning furnaces and 10-inch and 18-inch rolling mills for the production of structural steel, reinforcing steel and small plates. A tube mill may be added later. The mills will be motor-driven throughout, current being obtained from the power plant of the Doak Sheet Steel Co. At present eastern and southern pig iron will be used.

The third company to enter the steel field actively in San Francisco is the Columbia Steel Co., Portland and San Francisco, which has just completed and put into operation an open-hearth steel casting plant, at Black Diamond, some 30 miles from San Francisco. The plant consists of a 15-ton open-hearth furnace and complete equipment for the manufacture of mild, high carbon, manganese and alloyed steel castings. The main foundry is 260 feet by 130 feet, of steel and glass construction, and is fitted with electric cranes and motors throughout. The plant was laid out under the supervision of S. T. Wellman, who is consulting engineer for the company. Charles M. Gunn, San Francisco, is president and manager of the company.

The years 1910 and 1911 will, therefore, mark the starting into operation of two open-hearth plants on the south, and one on the north Pacific coast. These, together with the electric smelting furnaces of the Noble Electric Steel Co., signalize longer steps in the progress of the iron and steel industry of the Pacific coast, than have been taken in its entire history up to the present, and this, too, in the face of the unsettled conditions in iron and steel industries in the eastern and central portions of the United States.

The opening of these plants also indicates a change in the relations of the Pacific coast and the east, which will ultimately lead to the west depending less and less upon the eastern manufacturer for its supply of finished steel products. Taking the consumption of iron and steel products throughout the United States as a basis, it is found that on the Pacific coast there are approximately 3,000,000 people with a consumption of a million tons annually. A large percentage of this is now being shipped from the east, and the coast, having to pay an immense sum annually in freight bills, is realizing that this sum would go far toward building local plants and the activity at the present time shows that the realization is taking definite and concrete form.

Book Reviews

Experimental Investigations of the Power Required to Drive Rolling Mills.—By Puppe. 178 7½ x 11-inch pages. Illustrated. Translated from the German by Siemens Brothers Dynamo Works, Strafford, England. Philadelphia, 1910. J. B. Lippincott Co. Supplied by THE IRON TRADE REVIEW for $4.50.

This extremely interesting and valuable work records the results of a long series of tests carried out in German mills, of reversing and two-high types rolling various sections. The mills under observation were all electrically driven making accurate power absorption measurements possible. The work is divided into ten chapters which cover descriptions of the mills, the instruments and methods of investigation employed, influence of temperature, quality of metal and shape of grooves and sections in the power required, etc.

Diagrams showing power curves and efficiencies during the various tests are added in an appendix. The work can hardly fail to be of value to designers of rolling mill equipment.

Factory Accounts.—By Charles E. Hathaway and Jas. B. Griffith. 200 and VII 6 x 9-inch pages. Illustrated. Chicago, American School of Correspondence, 1910. Supplied by THE IRON TRADE REVIEW for $1.50.

The authors, who are respectively, the chief accountant of the Fore River Ship Building Co., Quincy, Mass., and the head of the department of commerce, American School of Correspondence have designed this work as a handbook of departmental organization as applied to factories.

The work is laid out in three principal divisions: Purchasing and stores department; records of labor and manufacturing orders, and general expense and cost summaries.

The first treats of filing systems for catalogs, quotations, and orders, stock keeping systems, tool records, etc. The second naturally involves a discussion of the various price rate and premium systems of which the form best known, Halsey's, Taylor's, Gault's and Emerson's, come in for most attention.

As with accountants generally the author's preference is for the system which involves the most intricacy and the free use of the term "standardizing" and ignores the every-day conditions which confront every shop manager, not of equipment and still less of lack of knowledge of costs, but of the human element—the workman, the most important gear in the whole train. It is in this particular where the Halsey plan excels others; it is the easiest installed and requires less, or no, changes from existing methods and will create less friction than others and achieve practically as good results as any, because in the first place it involves no arguments, and no arbitrary fixing of standard times, to arouse the opposition of the workman. Time keeping methods are treated at considerable length and illustrations of various forms adaptable to different lines of product are shown. Manufacturing orders and their subdivision are dealt with and suggestions made for their routing and treatment.

A Jobbing Foundry for Light Steel Castings

Description of the West Steel Casting Company's Plant, Equipped With a Steel Converter and Crucible Furnaces

All branches of the steel casting industry have shown marked advances in practice in recent years, and one of the most interesting developments is the tendency toward specialization, not only as to the size of the castings, but as to the quality of the output as well. The present generation of foundrymen can well recall the time when the gray iron foundry would undertake anything in the casting line from stove plate to the largest engine bed, and while the jobbing shops, today, do a wide variety of work, their output is largely limited to light, medium and heavy castings, respectively. The equipment required for light work is entirely unsuited for the production of heavy sections, and the difference in the shop arrangement, sands and other supplies, has led to the development of so-called specialty shops, for the most economical production of gray iron castings.

The need of specialization in the steel casting industry is, by far, greater than in the gray iron trade. The three processes of steel manufacture—open-hearth, converter and crucible—naturally divide the output into heavy, medium and light work, yet, only too frequently, the open-hearth plant will undertake the manufacture of light castings, for which the shop equipment is not only unsuited, but the nature of the metal is such that the castings can only be successfully produced after repeated trials accompanied by heavy losses. The difference in the fluidity of the metal, made by the three processes, is a factor of prime importance, and the sluggish metal for heavy work is not adapted for light castings. Furthermore, there is a marked difference in the cleaning equipment required for large and small sections, and as this is one of the largest items of expense in steel casting manufacture, it is essential that the greatest possible economies be effected in the cleaning department.

All of these factors were carefully considered by the officers of the West Steel Casting Co., Cleveland, prior to the erection of their plant, and after a careful survey of the market, it was concluded to make a specialty of medium and light castings, for which there appeared to ge a good demand in the district, in which the shop is located. The plant was designed and the melting equipment, consisting of a converter and crucible furnaces, was installed with that end in view. To insure economy of production, not only has modern equipment been provided, but methods of manufacture have been adopted that reduce losses to the minimum. It is well known that metal from bottom-pour ladles insures cleaner castings than when poured by the tea kettle or over-the-lip method. Appreciating the great advantages to be derived from bottom-pouring, it was decided to adopt this method for the converter steel produced. To insure the proper fluidity of converter metal for pouring light work it must be produced at a higher temperature than open-hearth steel. The searching tendency of exceedingly fluid converter steel makes it difficult to hold the metal with the stopper and this method of pouring is hazardous, unless the metal is under absolute control. In only a few shops in this country is converter steel successfully bottom-

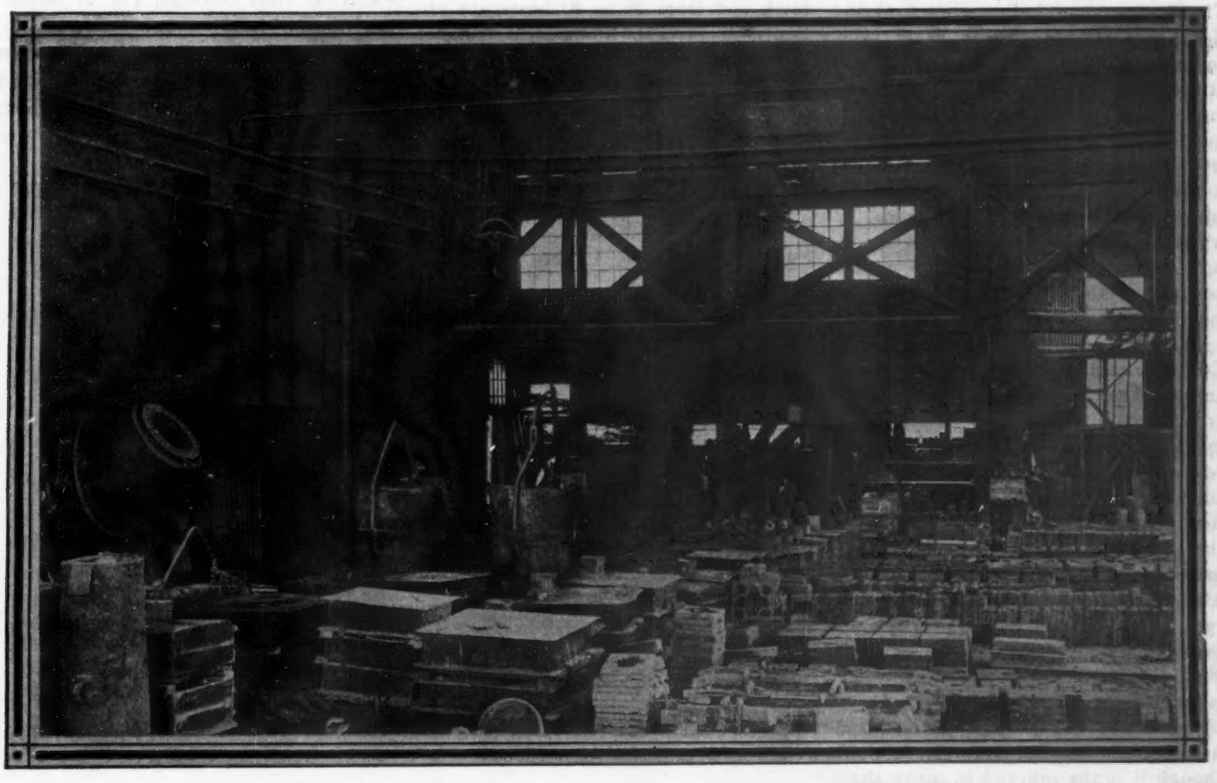


FIG. 1—VIEW OF ONE SECTION OF THE WEST STEEL CASTING CO.'S FOUNDRY.

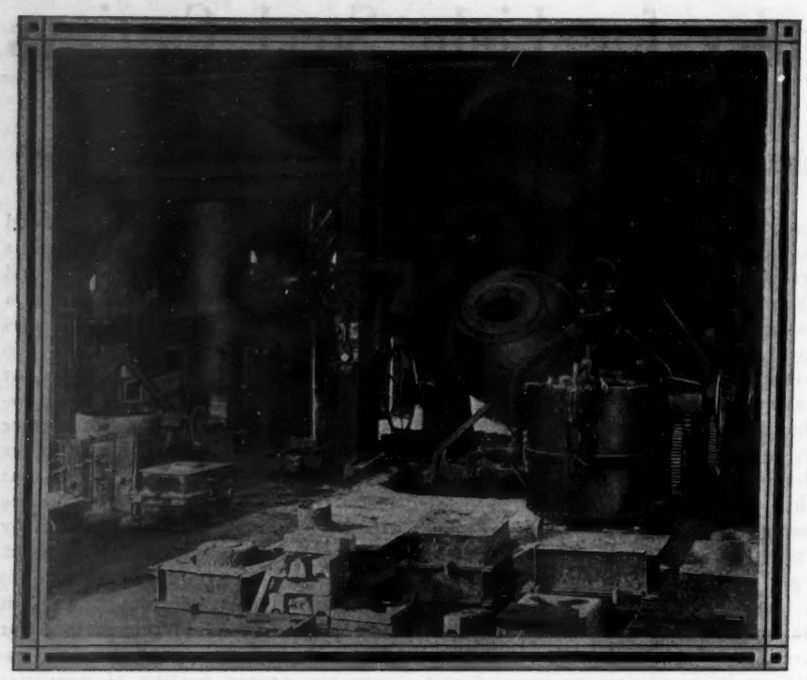


FIG. 2—ARRANGEMENT OF THE STEEL CONVERTER AND THE CUPOLA, WHICH FACILITATES THE TRANSPORTATION OF THE IRON TO THE BLOWING VESSEL.

poured, and the secret of this practice is carefully guarded. It was concluded that regardless of expense, this method would be pursued, and after many trials all difficulties were overcome and converter steel, for even the smallest castings, is now poured in this way. The bottom-pour ladles, shown at the right, Fig. 2, are of the usual type, equipped with graphite stoppers, which fit into fire brick nozzles. When pouring, a thick layer of slag forms on top of the steel, thus protecting it from the air and preventing it from cooling while pouring the molds. Alloy additions are made in the ladle, but when the amount is too great to insure a proper mixture in this way, a portion of the alloy is added to the metal in the converter.

The plant of the West Steel Casting Co. is located at East Seventieth street and the Lake Shore & Michigan Southern railroad tracks. The main building is 75 x 125 feet, and a large extension is to be built to provide for additional cleaning and molding facilities. A general view of one section of the plant is shown in Fig. 1. The melting equipment consists of one 6,000-pound converter of the Fisher type, Fig. 2, and two 8-pot crucible furnaces, shown in the background, Fig. 4. The metal for the converter is melted in a cupola, lined to 36 inches, installed by the Whiting Foundry Equipment Co., Harvey, Ill. Although it is the practice in many shops to use two converters, operated alternately to provide time for repairs and relining, an ample tonnage is obtained from this one vessel to meet the needs of the molding capacity of the shop, and steel is blown every day, regardless of repairs and relining. The converter is lined with high grade silica brick and from 25 to 40 heats are obtained from one lining. A ganister lining has been tried, but better results have been obtained with silica brick. The making of repairs and the work of relining is largely done at night. The average blast pressure for blowing the steel is about three pounds and the losses from oxidation, including the cupola melting loss, average from 18 to 20 per cent. The blowing of the steel requires from 20 to 30 minutes. The silicon in the cupola mixtures ranges from 2 to 2.50 per cent and the phosphorus, from 0.03 to 0.04 per cent. While the converter has a capacity of 6,000 pounds, it is lined to produce from 4,500 to 5,000 pounds at each heat. The present shop capacity is sufficient to handle the metal from six blows daily. The foundry is commanded by an electric traveling crane of 10 tons capacity, installed by the Cleveland Crane & Car Co., Cleveland. Although it is customary to have two cranes in converter shops, one to convey the metal from the cupola to the converter, while the other is carrying the ladle for pouring off the steel, a system of rapidly handling the metal has been devised, which obviates the necessity of using another crane. The cupola is operated by a fan, installed by the Buffalo Forge Co., Buffalo, and the blower for the converter was installed by the Piqua Blower Co., Piqua, O. The blowing equipment is located in the engine room, and only short sections of blast pipe are required to deliver the blast to the cupola and converter.

A large portion of the converter metal is utilized in the production of electrical steel castings, Fig. 3, including motor frames, pole pieces, etc. These castings are exceedingly low in carbon, are of high permeability, and an average analysis follows: Carbon, 0.10 per cent; manganese, 0.20 per

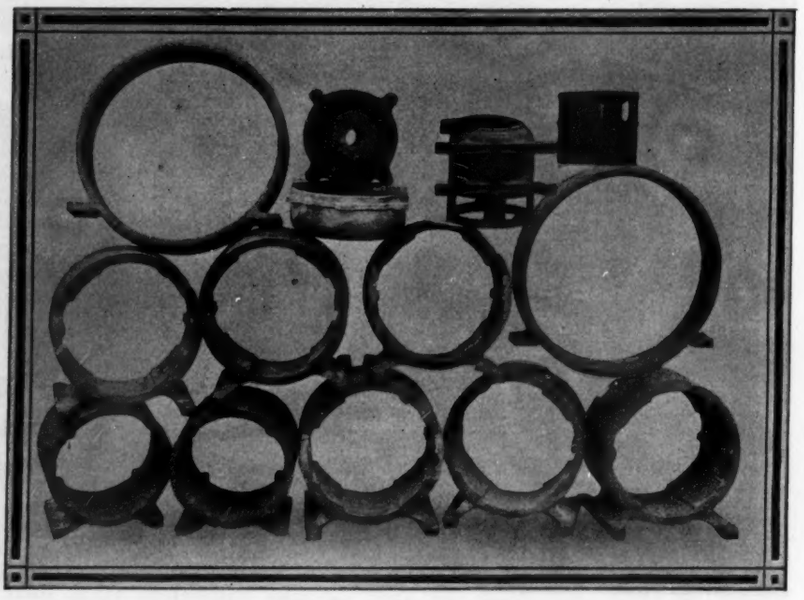


FIG. 3—MISCELLANEOUS ELECTRICAL CASTINGS MADE FROM CONVERTER STEEL.

cent; silicon, 0.10 per cent; sulphur, 0.03 per cent and phosphorus, 0.04 per cent. It will be noted that this analysis closely approximates that of pure iron. Tests of this steel made at the Case School of Applied Science, Cleveland, shown graphically in Fig. 6, indicate a flux density, in lines per square inch, of nearly 130,000 on 205 ampere turns per inch of length. The magnetization curves of Hadfield steel, annealed soft cast steel, wrought iron, unannealed cast steel, as well as gray cast iron, are also shown. In addition, cast steel car wheels, up to 20 inches in diameter, are also made from converter steel. The use of these wheels, not only for mining, but for other industrial purposes, is growing rapidly and for some uses cast steel wheels are replacing the product of the gray iron foundry.

The steel for castings for the jobbing trade is made of another mixture, which analyzes as follows: Carbon, 0.25 per cent; silicon, 0.25 per cent; phosphorus, 0.05 per cent; sulphur, 0.04 per cent and manganese, 0.70 per cent. Tensile tests of this steel show a strength of 65,000 pounds per square inch and an elongation of 30 per cent in 2 inches. Only low phosphorus pig iron, free from copper, is used for the converter mixture, and the cupola charge consists of 70 per cent pig and 30 per cent scrap. Shop scrap, consisting of gates, feeding heads, etc., is used almost exclusively, but owing to the low casting losses, it is occasionally necessary to purchase outside scrap for the mixtures.

FIG. 4—THE CRUCIBLE STEEL CASTING DEPARTMENT, SHOWING THE FURNACES IN THE BACKGROUND.

In the crucible steel department, the metal is utilized largely for the production of castings to meet the requirements of the automobile trade, and for small machine tool parts. The section of the shop devoted to this class of work is illustrated in Fig. 4, and the variety of the product is shown in Fig. 5. The two crucible furnaces are rectangular in form, 30 x 60 inches in size. They are a modification of the Milwaukee type, having no bridge wall, and in place of four oil pans for each furnace only two are provided. The fuel oil is conveyed to the furnaces by gravity from an elevated tank in the foundry yard, having a capacity of 150 gallons, sufficient for one day's operations. The oil storage tank is located outside of the building underground, and has a capacity of 6,500 gallons. From the storage tank, the fuel oil is pumped into a small tank which supplies the furnaces. Each furnace has a capacity of eight pots, but only the four nearest the front, or oil pan end, are within the melting zone, and each heat only consists of four pots. After the four crucibles in the front of the furnace have been lifted out, the four in the back, whose charges have been partially melted, are brought forward, and are ready for pouring in from 1½ to 2 hours. The vacancies caused by the removal of these pots are filled by four freshly charged pots, the contents of which have been warmed, but not preheated, by being placed at the end of the furnace near the stack. The two furnaces have a capacity of 48 pots per day. The fires are lighted at 4 or 5 o'clock in the morning and the first heat is ready at 8 o'clock. The crucibles average about three heats each,

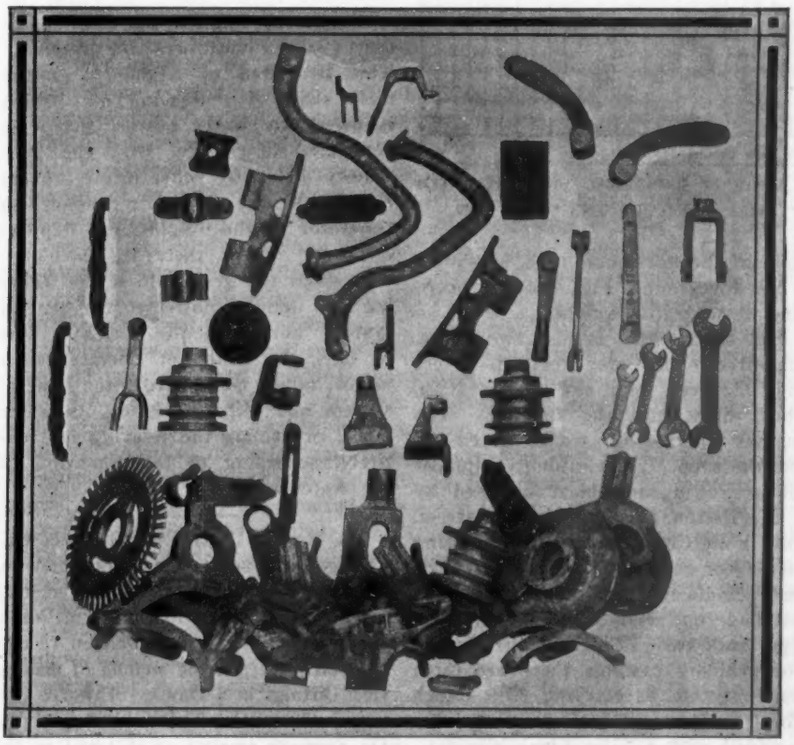


FIG. 5—MISCELLANEOUS CASTINGS MADE FROM CRUCIBLE STEEL.

although the life of some is prolonged by coating them on the outside with a mixture of ground crucibles wet with molasses water. The coating is approximately ¼ inch thick and is thoroughly dried by placing the pots in the furnace at the end of the day's work. It has been found that the cost of melting crucible steel is approximately 2 cents more per pound than by the converter process and 2½ cents more than in the open-hearth. When pouring-off the crucibles are set in a shank resting on two horses and are slagged-off by skimming with a flat-end skimmer, instead of being swabbed off with a ball of slag, on the end of an iron rod. After being poured, any remaining steel, insufficient to pour another mold, is emptied into the other crucibles still in the furnaces. Thus, every drop of melted steel is utilized to the fullest possible extent.

Castings that require annealing are placed in one of the crucible furnaces over night, the absence of bridge walls making it an excellent soaking pit. After the hot chamber has been filled with the hot castings, the bungs are closed and the damper to the stack is shut off. A small amount of oil is burned in one pan, the amount being gaged by the thickness of the castings to be annealed. The following morning the castings are removed by the watchman and the furnace prepared for the day's run. The annealed castings, when removed, have cooled down to their normal color.

The entire sand pile consists of silica sand, but a facing is used immediately next to the patterns. The molds are coated with a silica wash and are then dried in the ovens. A large amount of snap flask work is made, each flask being banded with hoop iron, as shown in Fig. 4. Many of these snap flasks are poured upright, as illustrated in the foreground, Fig. 4, in which case the bands have to be spread apart at one end to permit the pouring gate and risers to be taken out at the joint. These upright snap molds are dry and hard, and are merely blocks of sand without bottom boards or plates. They are held together by the iron bands, and are placed as close together as possible, the end mold being held by a large mold of the horizontal type, as shown in the foreground, Fig. 4, or by propping up with iron weights.

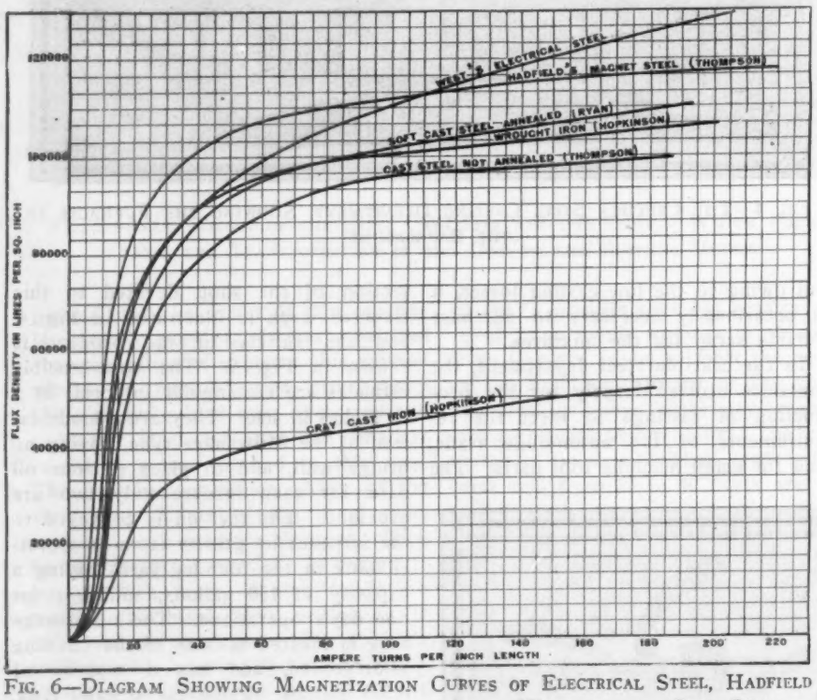


FIG. 6—DIAGRAM SHOWING MAGNETIZATION CURVES OF ELECTRICAL STEEL, HADFIELD STEEL ANNEALED AND UNANNEALED CAST STEEL, WROUGHT AND GRAY IRON.

For drying the molds, two large, coke-fired ovens are provided, 9 feet wide, 22 feet long and 9 feet high, which open into the foundry. The buggies operate on tracks extending into the shop. The cleaning equipment consists of a sand blast installed by J. M. Betton, 178 Washington street, New York City, Cape May sand being used. For cutting off gates and heads, three cold cutting-off saws have been installed, one 38-inch of the Newton type and two 22-inch, Espen-Lucas. For grinding castings there are three stationary stands carrying 30 x 3-inch wheels, and one swinging arm grinder provided with a 15 x 3-inch wheel.

The power plant is located in a wing to the main building and contains three gas engines, two of 50 horsepower capacity and one of 75 horsepower capacity, a 45-kilowatt, General Electric generator, air compressor, fan, blower, pumps, etc. The electric welding outfit, installed by the Lincoln Electric Co., Cleveland, has proved useful for repairing minor defects in castings and occasionally parts omitted from the patterns are welded into the castings, which, otherwise, would have to be rejected.

The cost of erecting and equipping a plant for the manufacture of light steel castings has been variously estimated, and it has been stated by some authorities that a converter shop could be built and equipped at a cost of $15,000. While this foundry, in addition to the converter, contains a crucible steel casting department which necessarily increased the cost, yet, notwithstanding conservative estimates, to the contrary, the outlay for the site, buildings and equipment, approximates $70,000.

The officers of the company are as follows: R. H. West, president; E. W. Pike, vice president and superintendent and D. P. Lansdowne, secretary.

A Unique Power Plant

At the Laconia mills, Biddeford, Me., the superintendent, W. S. Mitchell, is using a 200-kilowatt three-phase alternator as a link between a limited water power and a larger generating plant to transfer power from one to the other, in either direction, according to existing conditions, says *Power and the Engineer.* This is belted to a pulley on the main shaft of a weaving mill which is driven by water power, and it is connected in parallel with the generators driven by other prime movers and with the large turbine-driven generator of the neighboring Pepperell mills. When there is ample water power, the generator at the weaving mill delivers power to the general system, but when the water is low or fails, the generator operates as a motor, taking power from the general system and either assisting its water wheel or driving the weaving mill entirely, according to the condition of the water supply.

The Hawley Down Draft Furnace Co., Chicago, is issuing a monthly bulletin, describing its various lines of melting furnaces for use in iron, steel, malleable and brass foundries. A bulletin recently issued describes the method of making steel castings in a Hawley-Schwartz furnace and a formula is included, giving the requisite amount of material in the mixture.

Many Interesting Developments in the East

Decided Change in Conditions Compared With Close of Last Year — Limited Railroad Buying — Large Tonnage of Structural Material

By Chas. J. Stark.

A complete reversal of conditions from one year ago confronts the eastern iron and steel manufacturer at the beginning of 1911; last year he began the new period with operations near capacity, a well-filled order book and what appeared to be promising prospects for a continued maximum activity. At present, he finds his plant running at only slightly better than 50 per cent of capacity, his unfilled tonnage reduced and the business atmosphere disturbed and uncertain.

The past year in the eastern branch of the iron and steel industry at first glance appears to have been disappointing, to say the least. Certainly in the light of current conditions, embracing curtailed operations and bare cost prices, the state of trade offers little satisfaction to the ambitious manufacturer. From the traditional statement that the iron and steel business is a "feast or a famine," there would probably be little hesitancy in the classifying of the present conditions. Viewed from a broader aspect, but with a closer analysis of facts, such unfavorable conclusions must, in a measure, be tempered.

A considerable portion of the year has been occupied with the making of adjustments to meet a changing base of conditions and of a realignment of individual policies which had been established in accordance with the promising outlook for business that had prevailed early in the period. That a new high record of pig iron production for the country has been scored and that some finished lines have closely approached, if not exceeded, past high tonnage marks, in the estimate of competent authorities, give the year, at least the distinction of a time of large output. Attention is, therefore, directed to the present available capacity for iron and steel production and much of the widened spread between supply and demand may apparently be attributed to that source.

The eastern district has played a part, though probably not such a large part as other sections, in point of tonnage in this great expansion of production facilities which has come into effect following a period of active construction. New blast furnaces have been erected, others enlarged, steel works have been extended and there has been the adoption of methods which have been calculated to greatly increase former outputs. The iron trade in the east as well as in other sections had manifestly prepared itself for a time of greatly expanded consumption. Some increase has evidently been attained, but no comment is required that full expectations have not been realized.

The strikingly apparent lack of liberal railroad buying points to a source from which in due season some improvement may be expected to flow to the benefit of the general industry. In the meantime, the eastern iron and steel makers have put their houses in order for a period of waiting. High-cost plants have been put in idleness, more economical methods of operation are being followed and excessive increases of stocks have been checked. This curtailment, which has caused eastern production to shrink probably 50 per cent, has been accomplished in an orderly manner; its ultimate point may not yet have been reached, but the indications at the year's close were more numerous that the establishment of an equilibrium of trade has been closely approached.

Higher Business Plane.

Advanced thought and action in business affairs have been reflected in various important ways during the year. Of international importance from an iron and steel standpoint as well as of special significance as a gathering prompted by progressive business spirit, was the first annual meeting of the American Iron and Steel Institute at New York, Oct. 14. As a meeting of iron and steel manufacturers of the world, the assemblage was a notable one, since there were present 30 prominent iron and steel masters of the United Kingdom, Germany, Belgium, France and Austria, as well as the leading makers of this country. The meeting, which was followed by a week's tour of the leading iron and steel centers, ending by a day in Washington, represented the culmination of the plans for an active, effective organization in the advancement of American iron and steel affairs, which had been crystallizing since the founding of the American Iron and Steel Institute in March, 1908. Permanent headquarters were established in New York and the work of the Institute is now being directed from this source in a systematic manner. The movement towards improving the relation between employer and employe has been given considerable progress. Employers' liability has been a prominent topic for discussions at nearly all conventions of iron and steel and metal working machinery manufacturers held during the year. The United States Steel Corporation, Dec. 1, announced the consummation of the plans to pay pensions to employes, beginning Jan. 1, from the joint United States Steel and Carnegie Pension Fund, amounting to $12,000,000. In New York a state liability law was put into effect.

An interesting event of a historical iron and steel nature was the celebration by the Lukens Iron & Steel Co., at Coatesville, Pa., July 2, of the 90th anniversary of the rolling of the first boiler plate in America and of the approximately 110th anniversary of the establishment of the original portion of the present Lukens Works.

Steel-Making Developments.

Because of the uncertain business conditions of the year, some plans, which were in view by eastern iron and steel manufacturers for installation of capacity for the manufacture of steel by the electric process, were not carried out and the extension of facilities in this direction was not of an important scale. Some prominent developments in the adoption of the electric process of steel making in this country, however, came within the year. The United States Steel Corporation, after the successful completion of exhaustive experiments with the Heroult process at the Worcester, Mass., plant for the American Steel & Wire Co., acquired the exclusive rights under this method in the United States. The results obtained at Worcester, where a 15-ton furnace was operated, in connection with basic open-hearth furnace practice and as applied to the lighter and higher grade finished products, have been very satisfactory. The process there has been put upon a commercial basis and wire products have been manufactured which in their material have excelled the highest quality acid open-hearth steel, formerly made at this plant. These are now being furnished to the trade. A second 15-ton Heroult furnace is in operation at the South Chicago works of the Illinois

Steel Co. in connection with the Bessemer converter process and is being applied to the heavier products, such as rails, plates, axles, etc. This installation is still in the experimental state. The action of the United States Steel Corporation in taking over the exclusive rights of the Heroult process in this country indicates that important construction plans along this line are in prospect for the near future, but these have not yet progressed to the stage of definite announcement. The Crucible Steel Casting Co., Lansdowne, Pa., late in the year closed a contract for the installation of a two-ton electric furnace of the Roechling - Rodenhauser type, which will be used in the manufacture of crucible steel. From the interest now being shown in this direction, it seems highly probable that there will be more numerous adoptions of the electric furnace practice by crucible steel companies in the near future. The proposed installation of electric furnaces by the American Iron & Steel Mfg. Co., Lebanon, Pa., for the manufacture of merchant steel by this process, has been temporarily deferred, but this project may be revived early in the approaching year if business conditions become more staple. The first installation in the United States of the Girod electric furnace was made in the year by the Simonds Mfg. Co., Fitchburg, Mass., at its Chicago plant.

The duplex method of steel making attained a wider adoption in the east. The Maryland Steel Co. completed the construction of five 50-ton open-hearth furnaces at its Sparrows Point, Md., plant, which were employed in the duplex method of steel making during a part of the year. As the demands for ingot tonnage by the finishing mills became considerably reduced during the latter part of the year, the duplex method was temporarily discontinued, subject to the revival of a greater demand for finished products. The completion of the new Bessemer plant of the Bethlehem Steel Co., at Bethlehem, Pa., which is scheduled for early spring, will place the company in position to follow the duplex method on a large scale.

Pig Iron Movements.

Due to the optimistic expectations of consumers that the volume of business of the new year would require capacity operations, the eastern furnacemen had sold heavily against their outputs for first quarter and first half. Accordingly, they began the year with a large tonnage on their books. Even before the first of these shipments were well under way, the pig iron structure began to display symptoms of lessened strength in the movement which had carried prices upward $2.50 to $3.00 a ton during the preceding six months. It soon became apparent in many directions that business conditions of the roseate degree expected were not likely to be realized; consumers bought more timidly and the market began to settle. This weakness increased from month to month over the remainder of the year and during that period depressed prices from $2.50 to $3.00 a ton from the high mark of January. A study of pig iron prices of the year will show that the decline has been consistent and regular. The fact that quotations were more staple at the minimum figures at the year's close gave rise to the hope that the bottom had been reached. This view, grounded upon bare cost prices and a curtailed production, appeared reasonably accurate. As soon as it was recognized that the tide of business was running out, eastern blast furnaces took measures to meet the changed conditions. High cost stacks began to go out as early as April, and this movement continued over the year until production on Jan. 1 in the leading eastern districts had been cut to about 50 per cent of capacity and a compilation at the close of the year showed that of 35 leading merchant interests in eastern Pennsylvania and New Jersey, 17 were blowing and 18 were cold. Non-merchant activities were on a larger scale, as 13 furnaces connected with steel works were active, and six idle at the same time. A portion of this make, may be classed as merchant production, since some of the steel companies are sellers of iron. Though some of the furnaces were restrained from going out by the contracts for ore and other raw materials into which they had entered, the eastern furnace interests escaped some of this influence. Having bought largely of foreign ores, they were enabled through various arrangements to cancel and postpone shipments on these contracts and it is estimated that fully 300,000 tons of ore was held up and relinquished by the eastern furnaces.

The statistical position of the east at the beginning of the new year was not unfavorable. Stocks on the banks of the principal merchant producers in eastern Pennsylvania and in New Jersey were less than 100,000 tons, well distributed, and unfilled orders on books about 300,000 tons. In Virginia, the stocks were between 225,000 and 230,000 tons, of which about 170,000 tons, representing an accumulation of several years' standing, was in the hands of one large interest. Unfilled orders in that territory were about 90,000 tons.

Basic iron was one of the grades in which consumers over-estimated their requirements. As steel works operations declined, deliveries on iron under contract became more extended. Prices gradually fell under these conditions, and the lowest known figure of $14.50, delivered, was reached in October. During the latter part of March and April, fair buying was done for second and third quarter, about 50,000 tons being closed. During the rest of the year, buying was spasmodic. In November, a number of lots were booked, aggregating 30,000 tons for deliveries running through January. Considerable iron was carried over into the next year on old contracts. Some important changes in the balance of eastern basic supply and demand came in the year. The Worth Bros. Co., a hitherto large buyer, completed and blew in its new furnace at Coatesville, Pa., while the Alan Wood Iron & Steel Co., another large consumer, placed itself in a self-contained position by absorbing the two blast furnaces of the Richard Heckscher & Sons Co. at Swedeland, Pa. This transaction likewise practically takes from the market a large seller, when the steel works of the Alan Wood company are running full, which has not been the case since this transfer was made. The rehabilitation of the old furnace of the Tidewater Steel Co., at Chester, Pa., put a new maker of basic in the eastern field.

The Foundry Trade.

Foundry operations were irregular. Some lines of castings were in such demand as to provide a large melt. Other shops, especially those associated with railroad buying, such as the malleable and equipment plants, suffered for a lack of orders. The eastern cast iron pipe makers were heavy buyers, as usual, of low silicon irons, and divided their patronage between northern and southern furnaces. Pipe iron declined in the year from about $17.50, delivered, in January for the lowest grades to $14.25, delivered, in December, although as low as $14.00, delivered, was done in some cases, where buyers' plants were favorably located. One pipe maker renewed a sliding scale contract in the year for 18,000 tons of southern iron for six months shipment. Considerable Middlesborough iron was brought in by one of the Delaware River pipe companies during the year on engagements made near the close of 1909. These reached probably from 15,000 to 20,000 tons. Some tonnage of Swedish pig iron for special purposes was also sold and delivered in eastern Pennsylvania. Standard low phosphorus iron held firmly during the year. This was due in part to the scarcity of low phosphorus ores which limited the production. The electric furnace practice being followed by the United States Steel Corporation at the Worcester, Mass., plant of the Am-

erican Steel & Wire Co., has cut down the low phosphorus requirements of this plant probably 50 per cent.

The following represents the monthly range of prices during the year on basic and standard foundry grades of pig iron delivered to eastern Pennsylvania consumers:

	Basic.	2X Foundry.
January	$18.75 to 19.00	$18.75 to 19.25
February	18.50 to 18.75	18.25 to 18.75
March	18.00 to 18.50	18.00 to 18.50
April	17.50 to 18.00	17.50 to 18.00
May	16.25 to 16.50	16.75 to 17.50
June	15.75 to 16.00	16.50 to 17.00
July	15.50 to 15.75	16.00 to 16.25
August	15.00 to 15.25	16.00 to 16.25
September	15.00 to 15.25	16.00 to 16.25
October	14.50 to 15.00	15.75 to 16.00
November	14.50 to 14.75	15.50 to 15.75
December	14.50 to 14.75	15.50 to 15.75

Large Fabricated Tonnage.

Fabricated steel bookings in the year will not be far from 1,500,000 tons, which compares very favorably with 1906 the year of heaviest fabricating business in the history of the industry, when 1,600,000 tons was placed. Upwards of 750,000 tons was closed during the first half, but the tonnage fell off considerably during the last half, which is the usual rule in this market. Total offerings of the year are estimated at about 1,750,000 tons. The fact that regardless of this favorable tonnage so much dissatisfaction with business conditions in this line has been expressed, is apparently due to the greatly increased capacity which is competing for work. The present rated capacity of the principal fabricating shops of the country is now stated on good authority to be about 200,000 tons monthly. In the light of the comparison between capacity and business booked, the comment is hardly necessary that prices at times in the year have been very ragged and in cases have been at barely cost. On regular bridge work and building work in the metropolitan district, these have ranged from $50.00 to $55.00 per ton, erected. Had the railroads been liberal buyers of bridge work, the year would have greatly exceeded any other in history. The railroad awards, however, were less than for a number of years and were especially light during the last half of the year. Some very large contracts came up in the year. Those most prominent in which the east was directly interested included the 58,000 tons for mitre gates for the Panama canal, awarded to the McClintic-Marshall Construction Co., and 60,000 to 70,000 tons for the Quebec bridge, which is still pending. The metropolitan territory furnished a good tonnage. The largest prospective work in the district relates to subway extensions, and the estimated requirements from this source in the next several years under the planned improvements will probably be about 300,000 tons of plates, shapes and bars. Bethlehem sections gained considerable ground in the eastern districts and were specified freely. Among the other contracts awarded during the year in the east were 10,000 tons to the American Bridge Co., for New York Central terminal improvements in New York City; 10,000 to 12,000 tons to the Ft. Pitt Bridge Works, for bridge work for the Long Island Railroad; and 8,000 tons to the American Bridge Co., for the Bankers' Trust building, New York City.

Eastern plate mills received heavy specifications over the first half of the year and maintained a favorable scale of operations. Their activity declined over the second half. Some of them, with a widely diversified trade, were enabled to maintain about 70 per cent of capacity while others were working at about 50 per cent. Prices were regular most of the year, but in the last quarter, the 1.40c Pittsburg price was shaded at times on attractive business.

Railroad Buying Light.

The railroad buying of the year, in the aggregate, has been disappointing. At no time did these leading patrons of the iron and steel industry contract freely or in their accustomed amounts. During the first half of the year, their orders for cars, rails, bridges and supplies were more liberal, but the controversy over the freight rate increases cast a chill upon conditions and buying thereafter followed very meager lines. The iron and steel industry apparently has suffered more severely from the indifferent buying of the railroads than from any other factor. The railroads were slow to act upon their 1911 rail requirements and it was not until November that the books were opened by makers, whereas in 1909 they were opened in September. At that time, it was then announced that rails would henceforth be quoted upon a pound or 100-pound basis to harmonize them with other finished products. This means open-hearth rails are quotable at 1.34c or $1.34 mill, and Bessemer rails at 1.25c or $1.25 mill, according to the pound or 100-pound unit used. The first order to be placed for 1911 was that of the Erie for 33,000 tons and this was followed by the Norfolk & Western with 30,000 tons, the Louisville & Nashville with 27,000 and by other scattering lots. Early in December, the Pennsylvania announced its allotment of 150,000 tons, but owing to stricter specifications in physical tests and discard required, this order was still under negotiation at the year's close. The New York Central requirements, officially stated as 150,000 tons, were also on the verge of closing. This order similarly involves changes in specifications. Among the principal orders which were placed with eastern mills in the year for 1910 delivery were the Baltimore & Ohio, 70,000 tons, the Southern railroad, 45,000 tons, the New York, New Haven & Hartford, 13,500 tons, the Norfolk & Western, 11,000, and the Seaboard Air Line, 16,600 tons. The largest single car order of the year was placed in May, when the Harriman lines closed for a total of 12,400 cars, most of which went to the American Car & Foundry Co. In locomotives, the New York Central lines placed 323 for 1911 delivery with the American Locomotive Co.; the Southern Railway awarded 90 to the Baldwin Locomotive Works and the Baltimore & Ohio divided about 100 between the American and Baldwin companies. The Pennsylvania railroad also placed 88 with the Baldwin works. At the close of the year, the Harriman lines awarded 153 and the Boston & Maine 100 locomotives to the American and Baldwin companies.

Cast Iron Pipe.

Low prices prevailed all year in cast iron pipe. In the latter part of the year, under $19.00, at the foundry, was done for eastern shipment. This condition, with a very ordinary amount of business, made the year one of only fair size. Municipal work was moderate. The largest contract awarded in the east was for 21,600 tons for Portland, Me., placed with the United States Cast Iron Pipe & Foundry Co. The metropolis bought on a fair scale. One of the large contracts was 8,000 tons for Brooklyn in one letting. In private negotiations, the Consolidated Gas Co. closed for about 20,000 tons for its next year's requirements. Cast iron prospects at the year's end were somewhat more promising.

Bar Iron.

The bar iron market of the year was ragged in price and of limited tonnage. Prices sank as low as 1.25c mill. So unfavorable was the situation that some makers cut out their bar departments entirely and offered their mills for sale. The Iron & Steel Products Co., Philadelphia, was organized as a combination of a number of eastern mills, but this proved unsuccessful and the company went into the hands of a receiver in May. The Lebanon Valley Iron & Steel Co., Lebanon, Pa., was merged with the Lebanon Valley Iron Co., in

the year with a capitalization of $1,000,000.

Scrap Syndicate Dissolved.

Developments in connection with the old material market in the east during the year have furnished some interesting events. Some of these have centered about the syndicate method of buying, which had been put into effect the previous year by a number of the leading eastern consumers of heavy melting steel. The plan of filling their needs through one dealer who acted as a general purchasing agent enabled these users to obtain satisfactory results as to price and quality of material to cover their requirements. Large quantities of foreign material, estimated at from 70,000 to 80,000 tons, and including principally crop ends from the United Kingdom were imported. The methods pursued recommended themselves to the leading eastern iron scrap consumers and a similar buying arrangement was adopted, during the year. Agents of the government, upon thoroughly investigating the plans pursued by these buying syndicates, discovered features not in accordance with the federal antitrust regulations. Accordingly, it was suggested that a discontinuance of the arrangement as generally followed would be advisable. The manufacturers gracefully complied with this suggestion and the associations were dissolved. At the time of their abandonment, six leading steel works and seven iron mills were members of these associations.

A large tonnage of Panama canal scrap, estimated at about 25,000 to 30,000 tons, was brought in by the government. Early in the year, a bulk contract for all the Panama material was entered into by the government with a San Francisco syndicate at the price of $17.20 per net ton or $19.26 per gross ton at tidewater. It soon became apparent that the purchasers under this arrangement would sustain an enormous loss if the contract were enforced, which in part was due to the declining works activity. Accordingly a compromise was effected, the purchasers released, and the Isthmian scrap has since been offered and sold by cargo to the highest bidder upon its arrival at New York. These prices have ranged from $9.29 to $11.30, tidewater.

Heavy steel prices in the east were at the top point in January and declined steadily with basic pig iron throughout the year. During the first half, embargoes against the plants of a number of the eastern steel mills helped to depress the market. A little more active buying in September upon the completion of shipments of imported scrap interrupted slightly this downward movement. Other grades suffered corresponding decline and at the year's close consumers were either well covered or buying cautiously.

The almost unbroken decline of old material prices during the year is reflected in the following spread of prices on heavy melting steel and No. 1 railroad wrought, which ruled during the year:

	Heavy steel.	No. 1 R. R. wrought.
January	$17.00 to 17.50	$18.50 to 19.00
February	16.50 to 17.50	18.50 to 19.00
March	16.50 to 17.00	18.50 to 19.50
April	15.50 to 16.00	18.00 to 18.50
May	14.50 to 15.00	16.50 to 17.00
June	14.50 to 15.00	16.50 to 17.00
July	14.00 to 14.25	16.00 to 16.50
August	13.75 to 14.25	16.00 to 16.25
September	14.00 to 14.50	16.25 to 16.75
October	13.50 to 14.00	16.00 to 16.50
November	12.75 to 13.25	16.00 to 16.50
December	12.50 to 12.75	16.00 to 16.25

Monthly Tonnage Statements.

In recognition of the popular demand for greater publicity in the affairs of large corporations, the United States Steel Corporation by action of the directors began in July to issue monthly statements of unfilled tonnage of finished products upon its books. These periodical statements have reflected the steady decline in the general industry, of new business for finished products entered in proportion to the shipments made by the mills. As the curtailment of capacity proceeded gradually to lower levels, the establishment of equilibrium between the incoming and the outgoing tonnage was approached and at the close of the year this balance seemed about to have been effected with finishing operations at the stage of about 50 per cent of normal capacity. Since the plan of making monthly announcements has been followed, the comparative statements of business on hand and tonnage and percentage of decline from the previous month have been as follows:

	Orders in tons.	Decline. Tonnage.	Decline. Percentage.
Nov. 30, 1910	2,760,413	111,536	3.88
Oct. 31, 1910	2,871,949	286,157	9.12
Sept. 30, 1910	3,158,106	379,022	10.74
Aug. 31, 1910	3,537,128	433,803	10.92
July 31, 1910	3,970,931	286,863	6.72
June 30, 1910	4,257,794	.....	.....

Blast Furnaces (Non-Merchant.)

Bethlehem Steel Co.; two large modern stacks under construction at Bethlehem, Pa., will be completed in spring; daily capacity 500 tons each.

New furnace completed and blown in in April with capacity of 500 tons daily.

Alan Wood Iron & Steel Co.; third stack under construction at blast furnace plant of Richard Heckscher & Sons Co., at Swedeland, Pa., to operate alternately with two present furnaces; daily capacity 350 to 400 tons.

Worth Bros. Co.; new furnace completed and blown in during May at Coatesville, Pa.; daily capacity 500 tons; second stack of equal capacity under construction.

Blast Furnaces (Merchant).

Empire Steel & Iron Co.; Oxford furnace, N. J., enlarged and rebuilt and capacity increased to about 200 tons daily; one of Crane furnaces at Catasauqua, Pa., enlarged and rebuilt to 250 tons daily capacity.

Warwick Iron & Steel Co.; third stack under construction at Pottstown, Pa., to operate alternately with present two stacks; daily capacity 400 tons.

E. & G. Brooke Iron Co.; new furnace built at Birdsboro, Pa., and blown in during March; daily capacity 300 tons.

Reading Iron Co.; Emaus furnace at Reading, Pa., rebuilt and blown in; daily capacity 300 tons.

Delaware River Steel Co.; acquired, improved and operated furnace of Tidewater Steel Co., Chester, Pa.; daily capacity 200 tons.

Low Moor Iron Co.; rebuilding and enlarging furnace A at Low Moor, Va.; daily capacity 175 tons.

Jos. E. Thropp; Earlston furnace at Earlston, Pa., rebuilt and blown in in May; daily capacity 300 tons.

Allentown Iron Mfg. Co.; small charcoal furnace building at Allentown, Pa., with annual estimated capacity of 2,000 tons.

Steel Works.

Maryland Steel Co.; five 50-ton open hearth furnaces completed and put into operation at Sparrows Point, Md., to operate with Bessemer converter in duplex method of steel making.

Bethlehem Steel Co.; building Bessemer plant at Bethlehem, Pa., consisting of two 20-ton converters and 450-ton mixer to work with present open hearth plant in duplex method of steel making; will be completed in the spring.

Eastern Steel Co.; second 80-ton open hearth furnace added to works at Pottsville, Pa., doubling steel capacity.

Alan Wood Iron & Steel Co.; building hot metal bridge over Schuylkill river to connect its blast furnace department at Swedeland with open hearth works at Ivy Rock, Pa.; estimated will increase steel output about one-third.

Wickwire Bros.; third 35-ton open hearth furnace added at Cortland, N. Y.

Bethlehem Steel Co.; by-product coke plant of 300 ovens under construction by German interests at Beth-

lehem, Pa.; to supply gas and coke to steel works; daily capacity about 3,500 tons; eventually will be 600 ovens.

Maryland Steel Co.; increased ore handling facilities completed at Sparrows Point, Md., to accomodate greater Cuban ore movement.

Lackawanna Steel Co.; additional merchant mill to cost $800,000, authorized at Buffalo works.

Machine Tool Conditions.

During the early part of the year the machine tool trade was excellent and builders' plants were rushed to fill orders with the result that deliveries fell far behind. A notable feature of this demand was the buying of automobile interests, which reached large proportions. When it became apparent later that some of these companies had over - reached themselves, the demand fell away and some cancellations followed. The disturbing influence of the freight rate question checked the railroad buying, which had been running fairly strong. The final quarter of the year, accordingly, was rather quiet, but the year averaged one of fair proportions. Machine tool builders in their conventions during the year took further action toward enforcing the non-cancellation clause of contracts. Among the largest machine tool lists closed through eastern houses in the year were the Bethlehem Steel Co., $250,000; New York Central, $100,000; Delaware, Lackawanna & Western, $50,000; Missouri Pacific, $300,000 and others. The General Electric Co. also made some large purchases and had some heavy requirements out for its new Erie, Pa., plant.

Considerable Activity on the Pacific Coast

By Louis P. Zimmerman.

During the year 1910, more progress has been made on the Pacific seaboard in the manufacture of iron and steel and iron products than for many years past. Two events stand out prominently. On the north coast, the Western Steel Corporation began the manufacture of steel at Irondale, Washington, and on the south coast—at Black Diamond, California, the Columbia Steel Co. put into operation the only open-hearth steel casting plant on the Pacific coast. Both of these companies are finding a ready market for their products and indications point toward extensive enlargements of both plants within the current year. At San Francisco, the Pacific Coast Steel Co., is completing a rolling mill which will begin operation very soon.

The year 1910 started with indications of being a banner year in all lines, but before the first half was over, two important developments changed the outlook considerably. On the north coast, the machinists' strike caused a practical cessation of all activity and new work for the two months, June and July. It was not until August that normal conditions were again established. Soon after this, a decided depression in the lumber trade of the coast caused many foundries to close down all or part of their plants.

New Steel Plant.

The opening of the plant of the Western Steel Corporation marked the beginning of the importation of a considerable quantity of Chinese, Han Yang ore from Hankow, China, which is being used by the corporation, and locally for foundry work. In connection with its rolling mills and blast furnaces the Western Steel Corporation has begun the manufacture of steel castings for public consumption, for which there is a good demand, as heretofore the consumers have been compelled to obtain most of their castings from the east and Portland, Ore.

Prices on English No. 1 pig iron close about 50 cents per ton less than the opening price of $24, in January, while southern No. 2 has declined $2.50. The feature of the pig iron market for the year is the effort of the domestic iron makers to sell domestic iron on the Pacific coast in competition with the foreign irons offered. The year opened with very little southern iron in the market, but the closing months found many foundries buying small quantities at very close figures and generally from 25 cents to $2 under the market. The conditions affecting the Pacific coast are entirely local and are for the most part a reflection of the activity in the lumber trade.

Coke.

Coke has maintained almost a uniform price and quality throughout the year. Foreign coke is used very extensively. Beginning with 1910, the manufacturers of Wilkeson coke put into operation extensive coke and coal washers in an attempt to reduce the ash and sulphur of the local coke, but after a thorough trial it was found that the process was impractical, due to the nature and quality of the local coast coal available.

Common iron bars have maintained a steady and firm market throughout the year, closing 10 cents a hundred lower than the opening price of $2.30. Soft steel bars likewise closed 10 cents lower than their opening price of $2.50 in January. Buyers generally consider that the market has reached its lowest point and the next few months will see a material increase in price. The first half of the year showed a very firm and steady condition and brisk business in all sizes of sheets. In August, following eastern market conditions, a cut of 20 to 30 cents a hundred was made in all galvanized sheets. In the last of November, this was followed with a further reduction of 10 cents on all sheets, both blue annealed and galvanized, closing the year from 30 to 40 cents lower than the opening.

Scrap.

Cast iron foundry scrap has shown very little variation throughout the year, the market closing $1 higher than the opening price of $18 in January. During July and August, the price of steel scrap advanced sharply and then declined as abruptly when the steel interests went out of the market a little later, leaving the opening and closing prices practically the same.

A considerable tonnage of fence wire and nails has been a feature in finished products throughout the year. Jobbers look for a considerable increase and great activity in this line in the next few months.

It is interesting to note the comparison between the price quotations at the beginning of the year when southern iron was quoted slightly higher than foreign brands, and again later in the year when domestic iron was sold and quoted at a figure about $1.50 below foreign iron. This shows very clearly the absolute independence of the coast markets and the eastern market. The coast markets are influenced more by the activity in lumber and chartering of sailing vessels than by the conditions in the east.

British Columbia Hydro-Electric Plant

The first hydro-electric power plant in British Columbia, according to *Daily Consular and Trade Reports*, has recently been successfully completed. The company which undertook this project, known as the Bull River Electric Power Co., Ltd., was organized with an authorized capitalization of $2,000,000.

The plant is situated at the Bull River Falls, 13 miles west of Fernie, British Columbia, and $250,000 has already been expended in the work. It is estimated that some $300,000 more will be required to install the power plant and to erect 100 miles of poles and to string the wires.

A fall of 273 feet has been obtained in the Bull river by the construction of a flume 9,000 feet long, which takes water from the river above the falls and returns it below. Thus a head of 273 feet with a flow of 462 feet of water per second has been obtained. The flume, constructed of wood and built upon a rock foundation, is 30 feet wide by 7½ feet deep at the intake. The width is reduced to 16 feet within the first 1,000 feet, this width being kept to the end of the flume. The company is now preparing to install the penstock, which is to be of steel, 9 feet in diameter, and will rest upon bed rock the whole length, at an angle of 30 degrees. The foot of the stock will rest upon a natural bed rock, and a T-shaped cross pipe will be placed at the end of the stock in which the wheels will be placed. Three wheels of 4,200 horsepower capacity each will be utilized as the demand for power develops. The horsepower that can be obtained is estimated at 12,600.

The company expects to sell power to the city of Fernie on the east and Cranbrook on the west, and to the mining and other plants within the territory to be reached from its central location.

The committee in charge of the 1910 meeting of the International Congress of Mining, Metallurgy, Applied Mechanics and Geology, held in Dusseldorf, Germany, June last, has issued minutes of the proceedings in book form. The books, which are six in number, contain the papers and discussions on mining, practical metallurgy, theoretical metallurgy, applied mechanics and geology. A list of the members, as well as full details of the past meeting, are also presented. The work contains some 1,500 pages.

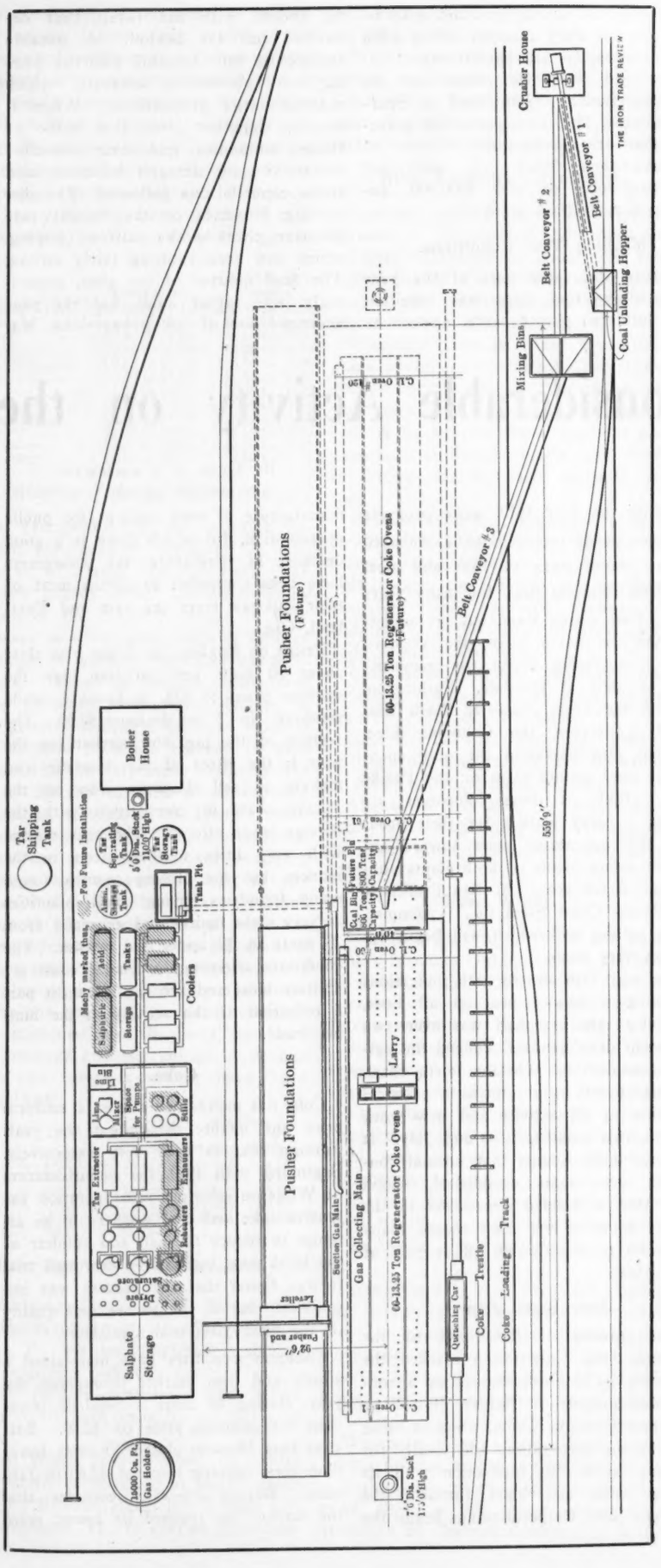


FIG. 1—GENERAL PLAN OF KOPPERS BY-PRODUCT COKE OVEN PLANT AT WOODWARD, ALA.

A New By-Product Coking Plant in the South

The Latest Example of the Modern Method of Coke-Making at the Woodward Iron Company's Works

One of the striking characteristics of the growth of the iron and steel industry during the past century is the steady progress which has been made toward efficient, waste-saving methods. Until within comparatively recent years pig iron was made exclusively in cold blast furnaces from which the gases were allowed to escape into the atmosphere. No one today would think of operating a blast furnace in this manner, or of not using regenerators with an open-hearth furnace. But the "standard" method of making foundry and furnace coke in a bee-hive oven, wasting all the gas and other by-products, is on precisely the same plane with the crude furnace methods of the early nineteenth century.

The wastefulness of the bee-hive oven is notorious and its amazing inefficiency is one of the principal reasons for the rapid growth of by-product coke making in this country. One of the most recent installations of this type of coke oven is found at the plant of the Woodward Iron Co., Woodward, Ala. This plant, which consists at present of 60 Koppers' cross-generator, by-product coke ovens, has a number of features that are worthy of detailed study.

The plant is designed for an ultimate installation of 120 ovens. Complete facilities for the recovery of the by-products have been provided, including apparatus designed by H. Koppers, Joliet, Ill., for the recovery of ammonia direct from the gas, and provision has been made for the installation of sufficient by-product capacity to take care of the gas from 120 ovens.

The plant is situated in the middle of the valley, about seven miles in width. The coke ovens are about a mile from the blast furnaces, and the surplus gas from the ovens is piped to the power plant at the furnaces. The coal mines are in the hills af one side of the valley, and the iron ore mines on the opposite side. The whole system of coal mines, coke ovens, blast furnaces and ore mines is connected by a railroad owned by the Woodward Iron Co.

The accompanying plans, Figs. 1, 2 and 3, show the general layout of the plant. The solid lines in Fig. 1 indicate the present battery of 60 coke ovens, while the dotted lines show the future extensions. Full advantage has been taken of the ample ground area available, and the works are laid out on a generous scale, which will prevent cramping and insure economical operation in the future. Since the mines are less than four miles from the ovens, and are owned and operated, together with the connecting railroad, by the Woodward Iron Co., there is no necessity for extensive coal storage at the ovens.

Each oven will have a capacity of 13¼ net tons of coal per charge. The total coal consumption per 24 hours for the 60-oven battery, with the ovens operating on 24-hour coking time, will be 795 tons; but the builder states that it is expected to operate these ovens on a 16-hour coking period. This will make a daily coal consumption of about 1,200 net tons. In this con-

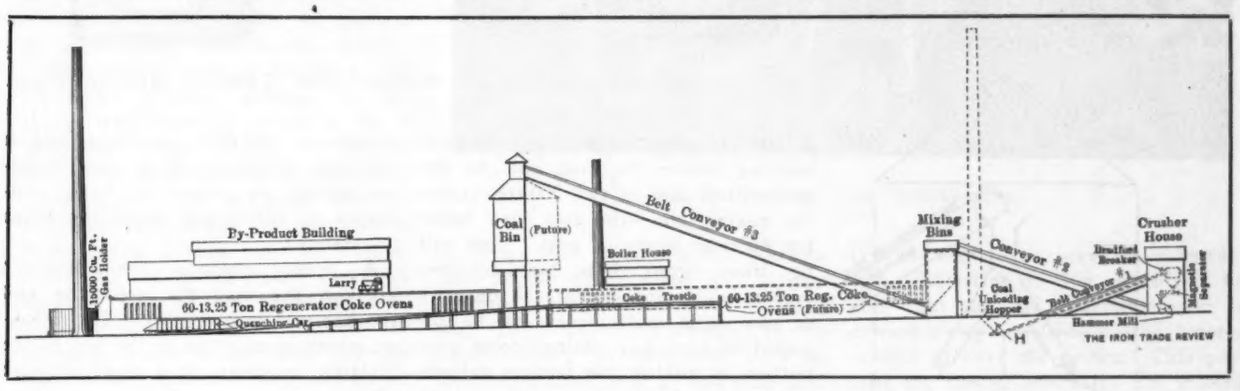


FIG. 2—SIDE ELEVATION OF WOODWARD PLANT.

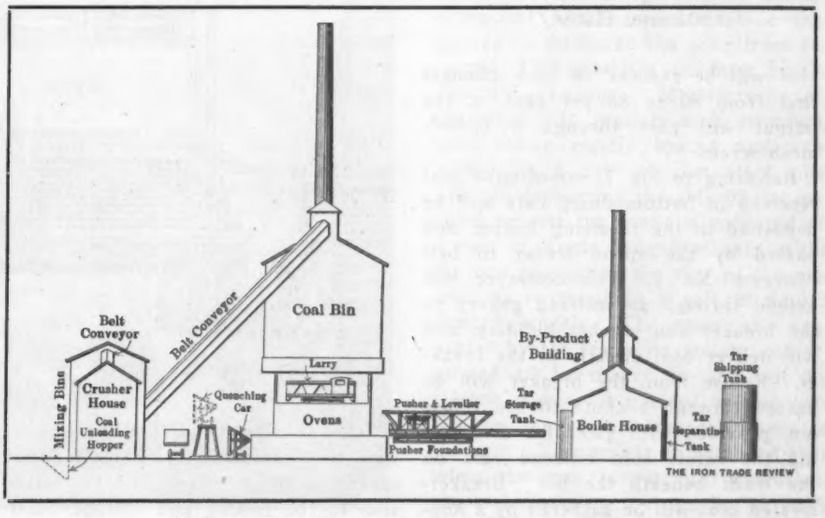


FIG. 3—END ELEVATION OF WOODWARD PLANT.

nection it is worthy of note that the Joliet, Ill., plant of 280 Koppers ovens, erected in 1907 for the United States Steel Corporation, is operating on a 17½-hour coking period, and the ovens at Woodward, Ala., will have some improvements which, it is expected, will make them even more efficient than those at Joliet.

The coal-handling plant is arranged for a prepared coal output of 1,200 net tons per day of eight hours; but all parts will be proportioned and designed on such a basis that the ultimate capacity is to be 2,400 net tons per day of eight hours.

Provision will be made for receiving and treating separately two kinds of coal, and for mixing these coals in any desired proportions. Prepared

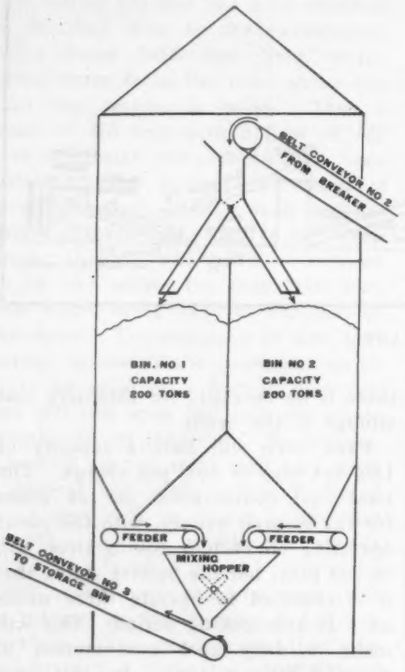

BELT CONVEYOR NO 2 FROM BREAKER
BIN. NO 1 CAPACITY 200 TONS
BIN NO 2 CAPACITY 200 TONS
FEEDER
FEEDER
MIXING HOPPER
BELT CONVEYOR NO 3 TO STORAGE BIN

FIG. 4—DIAGRAMMATIC ARRANGEMENT OF MIXING HOUSE.

coal will be reduced to such fineness that from 80 to 85 per cent of the output will pass through a ⅛-inch mesh screen.

Referring to Fig. 1, run-of-mine coal received in bottom dump cars will be deposited in the receiving hopper and passed by the apron feeder to belt conveyor No. 1. This conveyor will extend through an inclined gallery to the breaker and crusher building, and will deliver coal directly to the breaker. Refuse from the breaker will be passed through a chute to the refuse bin, provided with gates for discharging the refuse into railroad cars on the track beneath the bin. Breaker-treated coal will be gathered by a hopper and passed by a magnetic separator through the magnetic group to the crusher.

The product of the crusher will be delivered to belt conveyor No. 2, which will run through an inclined

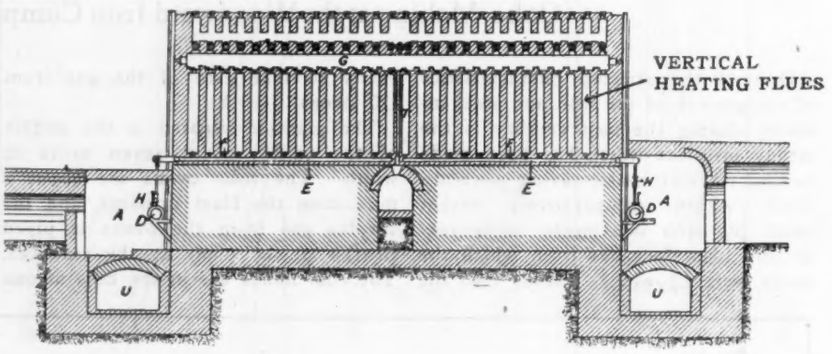


FIG. 5—LONGITUDINAL SECTION OF KOPPERS OVEN THROUGH HEATING FLUES.

gallery to the mixing and storage building where the coal will be deposited in either of two 200-ton capacity mixing bins—the two bins being for different kinds of coal. Coal will be drawn from these bins by two feeders so arranged that the quantity of coal from each feeder can be adjusted to give any desired fixed proportion in mixing, the feeders delivering to a coal mixer common to both units. Mixed coal will be delivered direct to a 400-ton capacity bin from which the oven larries are filled. Provision will be made for by-passing the coal from the mixer bins around the mixing equipment to the larry bin.

The additions that will be required to increase the output of the plant from 1,200 to 2,400 tons per day of eight hours will consist of one additional unloading unit, including a track hopper, an apron feeder, an extension to the breaking and crushing plant, with one additional breaker, magnetic separator and crusher—and an extension to the mixing and storage building comprising two 200-ton capacity mixing bins, two apron feeders, one coal mixer and one 400-ton larry bin.

In order to prolong the life of the belts, all conveyors will be run at half speed while the capacity of plant remains at 150 tons per hour, and it will only be necessary to change motor pulleys or pinions to bring conveyors to full speed when the plant is extended.

A house contains the Bradford breaker, the magnetic separator and the hammer mill crusher. The breaker, which is mounted at the top of the building, consists of a steel cylinder 12 feet in diameter and about the same length, with steel shelves or lugs fitted on the inside. These shelves lift the coal up, as the breaker revolves on rollers running on annural steel rings, until it slides off and drops. By repeated dropping, the coal is broken up until it will pass through the 2-inch diameter holes punched in the shell of the breaker. Discharge wings inside the breaker handle the heavy pieces of slate and refuse which are separated from the coal and pass them out through one end of cylinder. The breaker runs about 12 revolutions per minute and is driven by a 40-horse-power electric motor. The refuse is discharged into a self-cleaning con-

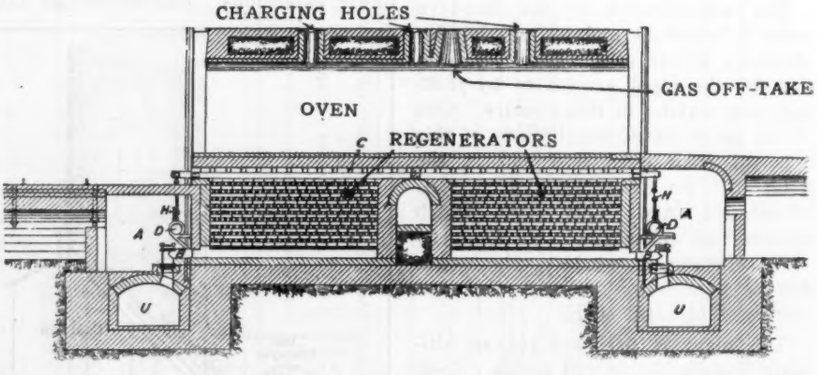


FIG. 6—LONGITUDINAL SECTION OF KOPPERS OVEN THROUGH OVEN CHAMBER.

crete steel bin. The good coal from the breaker is delivered into a steel hopper which discharges on to the magnetic separator.

The separator is simply a short belt conveyor 33 feet centers, provided with a magnetic head roll, which holds the iron on the belt until it passes the point of coal discharge. As soon as the metal leaves the magnetic field it is dropped into a chute.

The coal passes from the magnetic separator into a standard swing hammer crusher, which reduces it until 80 to 85 per cent will pass through a ⅛-inch mesh. Under the crusher is a steel hopper that discharges the coal on to the belt conveyor leading to the mixing bin. The crusher is operated by a 200-horsepower electric motor.

Two mixing bins are provided, conveyor No. 2 being arranged to discharge into either, as shown in Fig. 4. Each bin has a capacity of 200 net tons. The bins have 4-inch reinforced concrete walls and are fitted with ¼-inch steel plate hoppers at the bottom. Beneath the mixing bins are feeders similar to the feeder under the track hopper. The proper proportions of coal are obtained by regulating the discharge gates in the bins, and the speed of the feeders. From the feeder tables the coal is dropped into a hopper in which is installed a revolving shaft carrying paddles or mixing blades.

When the plant is finally completed the larry bins, of 1,600 tons capacity, will be situated between the two coke oven batteries. The larry bin is built of reinforced concrete with walls 4 inches thick. The bottom of the bin is formed into eight concrete hoppers, each hopper being fitted with a gate operated through levers from the scale box. The hoppers are arranged in two parallel rows, so that coal may be discharged from four at one time into the four-compartment larry car that operates over the coke ovens. A platform scale is provided to weigh the oven charges.

The over-all dimensions of the completed battery of 120 ovens, with their necessary coal bins, will be about 560 by 60 feet.

In a number of features the coke ovens at the Woodward plant are an improvement over previous construction. Referring to Fig. 1, it will be seen that the gas collecting main is carried along one side of the battery instead of over the center. This permits the use of one larry car instead of two in charging the ovens, saves labor and generally simplifies the construction.

The larry car has a capacity of 14 tons and runs on a 20-foot gage track on top of the ovens. Each oven has four charging holes and the body of the larry car is divided into four bins, of 3.5 tons capacity each, fitted with chutes. The car is electrically operated and charges one oven at a time.

After an oven has been charged with coal, the charge is leveled and distributed evenly by the mechanical leveler. The leveler is a part of the equipment of the same machine that is used to discharge the coke from the ovens. This machine was built by the Brown Hoisting Machinery Co., Cleveland. It consists of a structural steel frame rigidly braced and supported on a pair of cast steel sills. The sill supporting the side of the machine nearest the ovens is mounted on a pair of single flanged wheels, while the one supporting the rear of the machine is mounted on a pair of double flanged wheels. The rams are supported by the frame on rollers and arranged to be moved in and out by electric power. A gas seal is also carried on the same structural frame as the ram. This seal is so arranged that when the ram is put into operation, the seal closes up the opening through which the leveler is working, at the same time permitting the ram to work

FIG. 8—BUILDING THE REGENERATORS.

FIG. 7—PREPARING FOUNDATIONS FOR BATTERY OF 60 OVENS, WOODWARD, ALA.

FIG. 9—FINISHING REGENERATOR WALLS AND LAYING SILICA BRICK FOR OVEN FLOORS.

in and out, and prevents the escape of gas.

The entire machine is carried on two lines of rails spaced 30-foot centers, in which it is capable of movement at the rate of 250 to 300 feet per minute. The coke pusher, or lower ram, is arranged to be moved in or out after the door closing the oven has been removed and placed at one side of the aperture of the oven by the special door extractor mechanism. The door extractor consists of a small jib crane attached to the main frame of the machine. On this jib crane is arranged a trolley carrying a special lifting device for handling the oven doors.

The leveler ram is carried on cast steel rollers, which are so connected to the structural frame of the machine as to allow a vertical adjustment of the coal leveler bar or ram of 2 inches. The leveler bar or ram is made up of a pair of parallel vertical plates, firmly tied to each other by diagonal bracing so as to preserve perfect alignment. The backward and forward movement of the bar is controlled automatically by means of trips.

In some of the older installations the coke is pushed out on to an inclined wharf in front of the ovens, where it is quenched by a stream of water with a hose and later dropped into a larry car running on a depressed track in front of the wharf. At the Woodward plant a quenching car runs directly in front of the ovens. As the hot coke is pushed out of the oven it passes under a heavy stream of water before falling into the quenching car. Two 10-ton cars are used, drawn by an electric locomotive. After a car is loaded it is switched to the elevated coke trestle shown in front of the ovens in Figs. 1 and 2, from which the load is dumped into standard coke cars spotted on the loading track in front of the trestle.

The coke ovens are built from H. Koppers' latest designs. The details of a single oven are shown in Figs. 5 and 6. Each unit consists of an oven 37 feet long, 19¾ inches wide and 10 feet high inside, with two narrow regenerators underneath. The usual form of regenerator for coke ovens consists of two long chambers running the whole length of the battery. In case any repairs to the regenerators are required, this arrangement necessitates closing down the whole battery. The Koppers system obviates this disadvantage and also enables the hot air to be more satisfactorily distributed among the heating flues. There are 30 vertical heating flues on each side of each oven and, therefore, every oven is heated by the combustion of gas at 60 different points. The charge is consequenty subjected to exactly the same intensity of heat at all points and the desired uniformity in the quality of the coke is obtained.

A gallery, *A*, Figs. 5 and 6, extends the full length of the battery beneath the ovens and in front of the regenerators. A gas main, *D*, is installed in each gallery. Horizontal flues, *E*, Fig. 5, are laid under the vertical heating flues and removable nozzles connect the flue, *E*, with each vertical flue. A valve, *H*, is placed in the pipe connecting each of the horizontal flues, *E*, with the gas main, *D*. These horizontal flues are not continuous from end to end of oven, but extend only about half way, so that when one of the valves, *H*, is closed gas is admitted to only half of the vertical heating flues. Beneath the gallery, *A*, is a waste gas flue, *U*, which connects with the chimney at the end of the battery. Each regenerator is connected to the waste gas

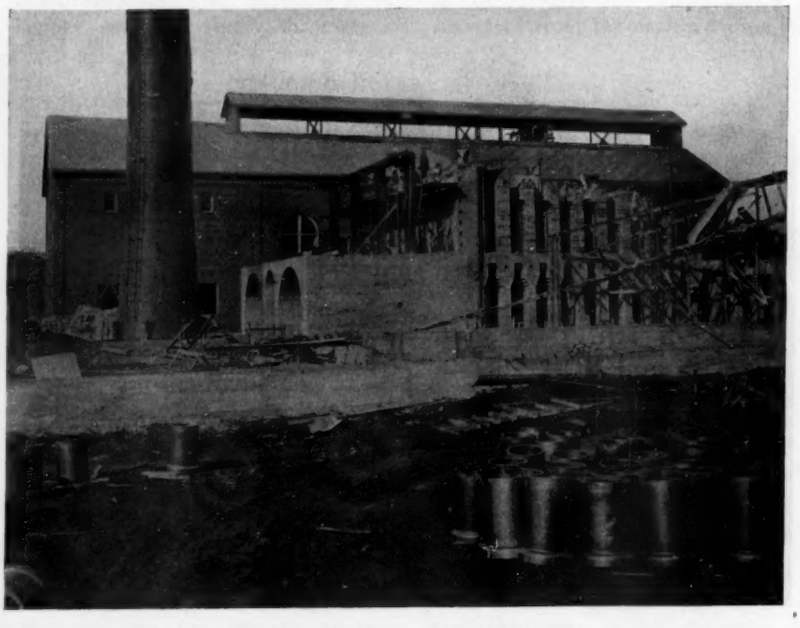


FIG. 10—LAYING UP OVEN WALLS.

flue through the three-way valve, *B*, Fig. 6, which may also be opened to the atmosphere.

The openings from the heating flues into the horizontal flue, *G*, Fig. 5, are covered by movable bricks which are used only to regulate the quantity of air entering the flues, thus positively controlling the combustion in each separate flue. The movable bricks and interior of the heating flues are accessible through openings in the top of the battery, these opening being provided with removable plugs.

The ovens and regenerator walls are built of silica brick manufactured by the Harbison-Walker Refractories Co.. Pittsgurg.

At the oven temperature of 2,300 degrees Fahr., the silica brick expands ⅛-inch per foot. To allow for this expansion the bricks are laid with loose joints which are filled with pitch. The pitch burns out when the ovens are fired and the bricks expand, keeping the joints tight. If ample provision were not made for this expansion the structure would be wrecked. Fire clay bricks are used for the checker work in the regenerators.

The oven being filed with fresh coal and sealed, its operation is as follows: During a period of 30 minutes air is admitted through the valve, *B*, Fig 6, into the regenerator under one end of the oven and after being heated by contact with the hot checker brick it enters the vertical heating flues extending over one-half the oven length directly over the regenerator. Here it meets with the gas which is admitted to these flues through nozzles connected to the branch main *E*, as previously described. The products of combustion pass up the flues, and into the chamber *G*, Fig. 5, from which they are led down through the vertical flues throughout the other half of the oven length and into the other regenerator underneath. Here they give up their heat to the checker brick and finally pass out into the chimney flue. At the end of 30 minutes the gas valves and air dampers are reversed and during the next half hour cold air and gas enter at the opposite end of the oven and combustion takes place in the vertical flues that previously served for the passage of waste gases to the regenerator.

Each gas valve and air damper is fitted with a lever. A flexible steel wire cable runs the full length of each gallery in front of the regenerators, passes around at one end of the gallery and returns. The gas valve and air damper are all attached to this cable, the former to the upper portion leading to the sheave and the latter to the lower portion returning from it; the cable is also wound around a drum geared to an electric motor at one end of the gallery. The motor is controlled by an electric clock through an auxiliary circuit. Every 30 minutes the clock starts the motor in opposite directions, thus shifting the cable to which the valve levers are attached. The motor is

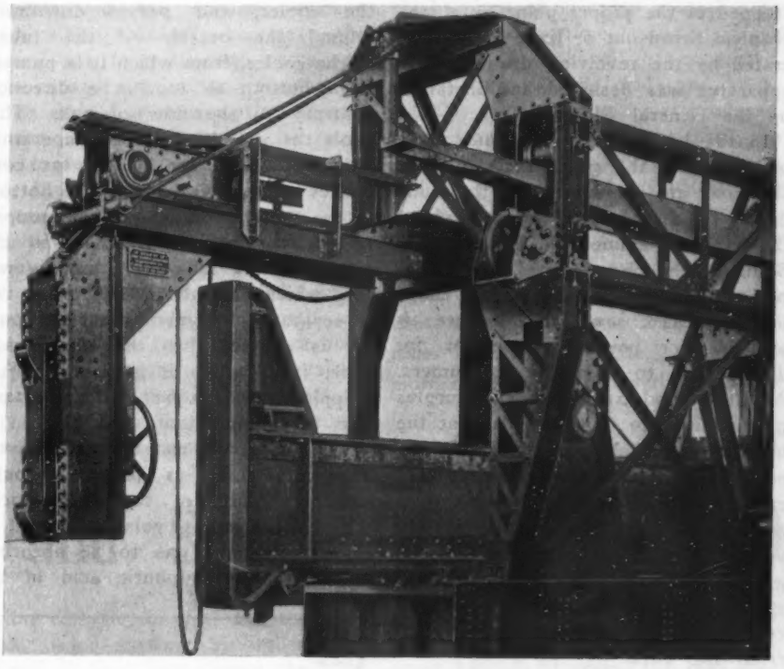


FIG. 12—BROWN PUSHER AND LEVELER.

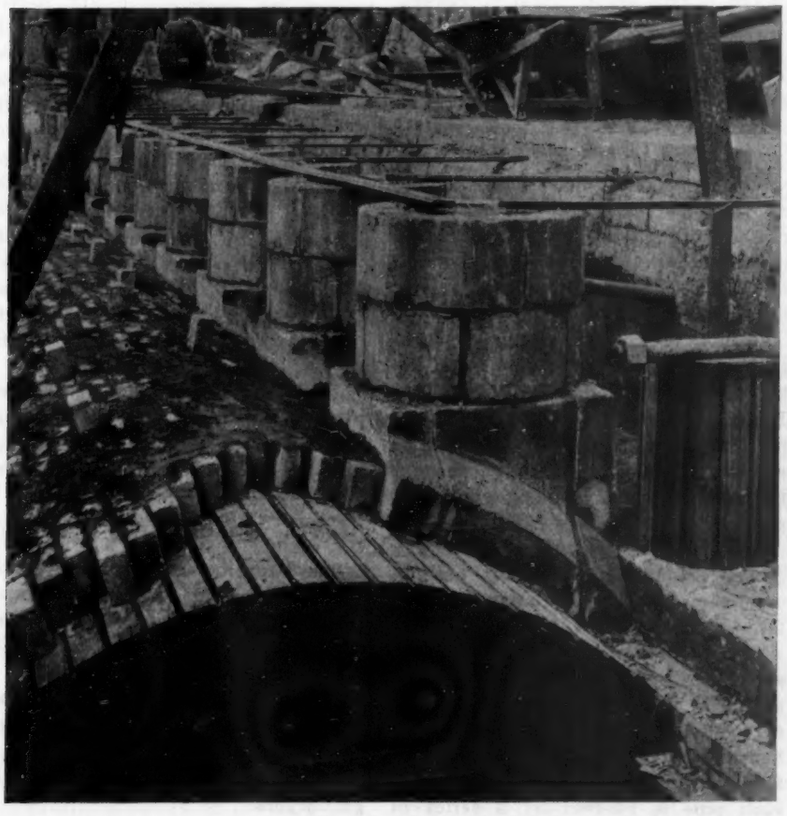


FIG. 11—WASTE GAS FLUE WITH NIPPLES CONNECTING TO REGENERATORS.

stopped at the proper point by a mechanical throw-out or limit switch operated by the revolving drum.* This apparatus was designed and installed by the General Electric Co.

In the by-product regenerator coke oven process the gases evolved from the coal are conducted to the condenser and saturator house, where the tar and ammonia are recovered. Some of the cleaned gas is then returned to heat the ovens in the manner described, and the balance is available for power purposes or for distribution to domestic consumers. At the Woodward plant the surplus gas is piped to a power plant at the blast furnaces, about a mile from the coke ovens. The Koppers oven, because of its system of heating flues and regenerator chambers, is said to be very economical in the consumption of gas, and the yield of surplus gas is stated to be as high as 50 to 60 per cent of the total quantity evolved from the coal.

Each coke oven is connected by a short ascension pipe, provided with a valve, to the 48-inch riveted steel gas collecting main, which extends the full length of the battery, as shown in Fig. 1. This main connects with a 30-inch suction main, which conveys the gas to the by-product plant. The collecting main and suction main are flushed with tar which is pumped through continually in order to prevent deposits. The temperature of the gas in the collecting main is about 300 degrees Fahr.

The by-product plant is situated back of and parallel to the coke ovens. As shown in Fig. 7, it occupies a plot of ground 330 by 50 feet, the by-product building itself being 160 by 50 feet. The plant is laid out to take care of the gas from 120 ovens, space being left for the installation of additional equipment when the remaining 60 ovens are built. With the present equipment the plant is designed to handle 12,000,000 cubic feet of gas daily. All of the by-product equipment is installed with reserve apparatus to be turned on when cleaning or repairs are necessary.

The gas first enters the tubular coolers or condensers, where a large portion of the tar is condensed. Three coolers have been installed, with space reserved for two more. One of the three is a spare cooler. The coolers are similar to surface condensers and each consists of a rectangular steel shell fitted with headers in which a large number of boiler tubes are expanded. The gas enters the top of the cooler, and passes downward around the outside of the tubes, of the cooler, from which it is pumped from bottom to top, in a direction contrary to the flow of gas. This cools the gas down to a temperature of about 95 degrees. The tar condenses out and collects in the bottom of the cooler from which it is pumped to the tar separating tank. In the tar separating tank the ammonia water, which is entrained by the tar, is separated by gravity and the pure tar is pumped into the tar storage tank, from which it goes to the tar shipping tank to be loaded in tank cars for shipment.

The ammonia water from the tar separating tank is passed through ammonia stills of the usual form. The NH_3 gas is volatilized and is mixed with the gas to be absorbed by the dilute sulphuric acid in the saturator. Only the small amount of ammonia entrained in the tar is passed through the still and treated in this manner, the bulk of it being recovered direct from the gas, as will be explained later.

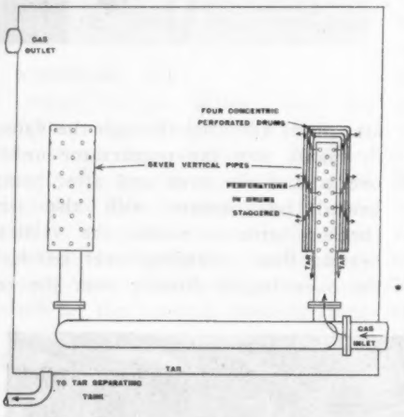


FIG. 13—DIAGRAM SHOWING CONSTRUCTION OF P. & A. TAR EXTRACTOR.

From the coolers the gas passes through one of two steam-driven exhausters furnished by P. H. & F. M. Roots, Connersville, Ind. This apparatus pumps the gas with a constant vacuum from the ovens and forces it through the by-product apparatus.

Leaving the exhauster the gas passes through P. & A. tar extractors, which remove the balance of the tar. Two extractors of improved design are installed, one being a spare apparatus, and space is reserved for a third. Seven vertical pipes connected to the gas main from the exhauster are placed inside the extractor, as shown in Fig. 8, and the end of each pipe is covered by a series of concentric steel drums. Staggered holes are punched in the drums and the gas is thus forced to take a zigzag route on its way out, impinging on the walls of the successive drums intercepting the tar. The tar is drained from the bottom of the extractor and is pumped to the separating tank.

From the P. & A. extractor the gas passes through one of two tubular reheaters containing exhaust steam from the exhausters, in which it is heated to a temperature of 160 degrees Fahr., at which temperature it passes directly into the sulphuric acid saturator.

In the old system of gas treatment, the gas is first cooled in condensers to remove the tar and then washed or scrubbed with water in a series of scrubbers to remove the ammonia, which is collected as a solution of weak ammonia liquor. This weak liquor is then concentrated by treatment with steam in ammonia stills. The product of the stills is either shipped in the form of concentrated liquor, containing 15 to 20 per cent of NH_3, or the hot concentrator vapors are passed into sulphuric acid saturators to form ammonium sulphate. The handling of large volumes of ammonia liquor necessitates bulky apparatus and results in the loss of considerable ammonia. Furthermore, in this old system the saturators are operated at 212 degrees Fahr., at which temperature they deteriorate rapidly and repairs are heavy.

In the Koppers direct process employed at the Woodward plant, the gas from the reheaters is passed directly into one of two saturators at the comparatively moderate temperature of 160 degrees Fahr. Two saturators are installed at present, one being in reserve, and a third will be added later. The saturators are closed cast iron vessels lined with sheet lead. The gas enters at the bottom and bubbles through a bath of dilute, 3 to 5 per cent sulphuric acid. The reaction takes place in the presence of an excess of water, forming ammonium sulphate, according to the following equation:

$$H_2O + 2NH_3 = (NH_4)_2SO_4 + H_2O.$$

The saturators are operated continuously, receiving sulphuric acid and ammonia laden gas and discharging ammonium sulphate constantly. This ammonium sulphate, $(NH_4)_2SO_4$, in the form of a thick mother liquor, is ejected from the saturator into a lead-lined draining tank which is emptied periodically into the centrifugal dryers.

Two dryers are installed, one for

*See IRON TRADE REVIEW, Aug. 11, 1910.

each saturator. They are made in Germany and consist of a revolving basket of perforated sheet metal mounted on a vertical shaft connected to an electric motor. The basket revolves at a peripheral speed of 10,000 feet per minute and the water is driven out through the perforations by centrifugal force, leaving the dry ammonium sulphate salt behind.

The sulphate is discharged from the dryer into a small bottom-dump car. The car is hoisted on a platform elevator and runs on an overhead track in the sulphate storage room, dropping its load on the storage piles.

A 15,000 cubic foot gas holder is situated near the sulphate storage room. This holder receives the cleaned gas from the saturators and takes care of any minor irregularities in the supply or consumption of gas. It also furnishes the requisite pressure to force the gas, used as oven fuel, back to the ovens.

Steam is furnished by two 250-horsepower Rust water tube boilers equipped with a 300 rated horsepower feed water heater and two feed pumps. One boiler and one feed pump are held in reserve. Later one more boiler, pump and heater will be installed. Gas is burned under the boilers.

The following figures represent approximately the annual performance of the plant of 60 ovens operating on 18-hour coking time. About 387,000 net tons of coal will be consumed, 290,000 tons of coke made and 3,870,000,000 cubic feet of gas produced, since from the coal to be used the yield of coke is about 75 per cent and the production of gas 10,000 cubic feet per ton of coal. About 2,000,000,000 cubic feet of gas will be annually available for power purposes. About 2,000,000 gallons of tar will be reclaimed, which brings from 2 to 3 cents per gallon. The annual ammonium sulphate production will be from 3,870 to 4,838 net tons, or from 20 to 25 pounds per ton of coal.

The Production and Sale of Coke in 1910

A new high production record was established in the Connellsville, Pa., coke regions during the year 1910, while prices declined steadily from the opening of the year until the close. Lacking the weekly production reports for the last two weeks in December, the total production for 1910 in the Connellsville regions is given as 20,575,134 tons, compared with 17,785,832 tons in 1909; 10,700,022 tons in 1908; 19,029,058 tons in 1907; 19,999,326 tons in 1906, and 17,896,526 tons in 1905.

The highest production record for any single week in 1910 was for the week ending Jan. 29, when the Upper and Lower Connellsville regions produced 474,496 tons, this being the record for the regions. From that time forward the output steadily declined, but did not go below the 400,000-ton mark until the last week in April, when the total production amounted to 372,803 tons. The 400,000-ton mark was reached again early in June and the early part of July, when a number of furnace interests, which had previously secured their supply of coke from other districts, were obliged to draw from the Connellsville field on account of the suspension of mining operations as a result of the general strike of the miners. During the week ending Nov. 26, production dropped to 285,049 tons, the lowest record for the year up to Dec. 17, a decrease of 189,447 tons, as compared with the highest weekly record in January.

At no time from Feb. 1 until the close of the year were the producers able to control the market, production being greatly in excess of consumption, with the result that prices began to decline early in the year and the minimum price quoted by sellers on prompt furnace coke during the year was from 5 to 10 cents below the lowest price at which actual sales were made in 1909. During the latter part of January prompt furnace coke was sold at $2.75, ovens, as compared with $1.35 ovens, the low price of the year established in October, and $1.45 ovens, at which sales were made during the early part of December. During the initial month contracts were made at $2.80 and $2.90, ovens, while standard Connellsville furnace coke for delivery over the first half of 1911 was sold during the closing month as low as $1.60, ovens. The price of prompt foundry coke declined $1 a ton during the year, several sales having been made during December at $2 ovens. On contracts, prices of foundry coke dropped from $3.35 ovens, to $2.25 ovens, although some of the larger sellers in the Pittsburg district did not sell any foundry coke for either prompt or forward shipment below $2.50 ovens.

Connellsville Coke Production.

(Compiled from the weekly reports of the Connellsville *Courier*.)

Week, 1910.	Ovens.	In blast.	Out blast.	Tons.
Jan. 1....	39,158	36,272	2,886	449,082
Jan. 8....	39,219	36,286	2,933	454,007
Jan. 15....	39,219	36,343	2,876	457,415
Jan. 22....	39,419	36,794	2,625	471,222
Jan. 29....	39,419	36,859	2,560	474,496
Feb. 5....	39,419	36,859	2,560	474,203
Feb. 12....	39,319	36,653	2,666	466,344
Feb. 19....	39,425	36,645	2,780	463,123
Feb. 26....	39,425	36,427	2,998	461,774
Mar. 5....	39,425	36,419	3,006	467,311
Mar. 12....	39,455	36,500	2,955	464,892
Mar. 19....	39,455	36,474	2,981	462,320
Mar. 26....	39,455	35,988	3,467	453,986
Apr. 2....	39,459	35,668	3,791	455,273
Apr. 9....	39,459	34,364	5,095	447,508
Apr. 16....	39,459	33,794	5,665	438,374
Apr. 23....	39,459	33,259	6,200	425,152
Apr. 30....	39,346	30,284	8,962	372,803
May 7....	39,308	30,412	8,896	394,414
May 14....	39,308	30,441	8,867	396,777
May 21....	39,308	30,420	8,888	393,185
May 28....	39,308	30,422	8,886	396,443
June 4....	39,403	30,357	9,046	388,294
June 11....	39,404	30,336	9,068	401,737
June 18....	39,478	30,183	9,295	404,803
June 25....	39,468	29,631	9,837	393,476
July 2....	39,418	29,498	9,920	400,226
July 9....	39,454	29,465	9,989	350,993
July 16....	39,456	29,357	10,099	404,543
July 23....	29,454	29,430	10,024	406,507
July 30....	39,454	29,580	9,874	409,206
Aug. 6....	39,454	29,540	9,914	406,505
Aug. 13....	39,454	29,371	10,083	367,273
Aug. 20....	39,454	29,186	10,268	365,724
Aug. 27....	39,454	28,983	10,471	361,913
Sept. 3....	39,494	27,715	11,779	342,775
Sept. 10....	39,134	27,361	11,773	341,734
Sept. 17....	39,134	27,369	11,765	343,630
Sept. 24....	39,134	27,105	12,029	344,765
Oct. 1....	39,132	27,258	11,877	345,390
Oct. 8....	39,132	27,558	11,574	350,315
Oct. 15....	39,132	27,495	11,637	351,988
Oct. 22....	39,132	27,469	11,663	351,085
Oct. 29....	39,132	27,414	11,718	347,896
Nov. 5....	39,132	27,163	11,967	340,556
Nov. 12....	39,132	26,368	12,764	327,860
Nov. 19....	39,132	26,288	12,844	326,056
Nov. 26....	39,132	23,961	15,171	285,049
Dec. 3....	39,132	23,965	15,167	289,668
Dec. 10....	39,197	24,010	15,189	292,435
Dec. 17....	39,197	23,891	15,306	292,617
Dec. 24....	.....	.....	.....	*280,000
Dec. 31....	.....	.....	.....	*250,000
Total				20,575,134

*Estimated.

The following table shows the average monthly quotations on furnace and foundry coke for prompt shipment during the year 1910, at the ovens:

	Furnace.	Foundry.
January	$2.57	$3.02
February	2.31	2.92
March	2.03	2.78
April	1.61	2.53
May	1.61	2.29
June	1.63	2.15
July	1.60	2.10
August	1.61	2.17
September	1.60	2.12
October	1.59	2.07
November	1.49	2.01
December	1.45	2.00

Two exceptionally large transactions involving furnace coke were negotiated during the year. One of these was the three-year contract made by the Jones & Laughlin Steel Co., through a Pittsburg broker, for approximately 25,000 tons of coke a month for a period of three years. The other was the contract placed by the Cambria Steel Co., Johnstown,

Pa., through Matthew Addy & Co., for Tower Hill coke, involving a minimum tonnage of 15,000 tons a month and a maximum of 20,000 tons a month for a period of two years, with an option to the steel company for an equal amount over the third year. Late in November the Youngstown Sheet & Tube Co. closed with the Rainey interests for its full requirements of furnace coke for 1911, aggregating from 25,000 to 35,000 tons a month. The Wheeling Steel & Iron Co., Wheeling, W. Va., during the same month closed for 30,000 tons of furnace coke a month over a period of two years on a sliding scale basis. Several other large consuming interests during the fourth quarter closed for their 1911 requirements, aggregating from 10,000 to 25,000 tons a month on a sliding scale basis. Some of the larger consumers, including Corrigan, McKinney & Co., Republic Iron & Steel Co. and others, since July 1 have been covering for their coke requirements from month to month, buying in the open market.

Comparatively little new construction work was carried on in the Connellsville coke region during the year. When the building season opened early last spring, the coke market was in an unsettled condition and the outlook for the remainder of the year was not very bright, with the result that prospective builders decided to postpone actual construction of new ovens, on which plans were prepared the previous year.

Negotiations were renewed during the year for the establishment of a central coke selling agency or the merger of the leading producing companies in the Connellsville region, and while neither plan has been adopted, producers have not abandoned hope of forming a selling agency or of merging several of the larger companies. It is expected that definite action on one of these propositions will be taken the early part of 1911.

On Jan. 1, 1910, the H. C. Frick Coke Co., as well as the independents, restored the wage scale of workers in the Connellsville regions to the level in effect prior to the general reduction on Jan. 1, 1908.

There were practically no labor disturbances in the Connellsville regions during the year, and contrary to conditions existing in previous years, little trouble was experienced on account of a shortage of water.

The German Iron and Steel Trade in 1910

By M. Hoeck.

The year 1910 has not fulfilled the promise under which it began. Continuous improvement in the prices and output of all articles had been expected, but there have been as many waves during the past twelve months as are generally seen in a year. Taking it altogether it must be admitted that the year 1910 means a step upward in German iron and steel history, not only as regards an increase in production, but as well the development of technical and economical possibilities.

The German production of pig iron in 1910 will exceed 14,000,000 tons, which means a record. The largest production up to this year had been 13,045,760 tons in 1907, with 11,813,511 tons in 1908, and 12,917,653 tons in 1909. The production of steel products exceeds 13,000,000 tons, against 12,049,834 tons in 1909. The production per capita of population will be about 0.215 kilograms (0.474 pounds) while the consumption per head will be about 130 kilos (0.286 pounds).

The year opened with very irregular prices, except on the products sold by the Stahlwerksverband and some other syndicates. Pig iron quotations especially were most irregular and so low that only works with the very best installation could see their money back. The raw materials, coke and ore, were at bottom prices, but they have advanced strongly without any interruption. The increase in the coke prices during the year amounts to about two marks (50 cents) per ton, but the ore prices have gained four marks ($1 per ton on the average. These increases made it necessary for the blast furnaces to form an agreement on the sale of pig iron, and the new combine raised the price for hematite from 58 marks to 70 marks per ton ($13.75 to $19) and this latter price has now been paid for contracts into 1911. The works suffered most heavily in the scarcity of orders for railway material, as business could be obtained only from abroad and at very low prices. Due to the fact that the state railways did not give out sufficient orders, some of the largest makers of railway material had to close their shops for months. As the principal lines of the state railways had been rebuilt during 1906-1908, there was no demand for new rails, etc.

The building trade, and with it the business in girders, beams, etc., got a big set back in the spring by a general strike of the building workmen. About three months elapsed before this strike was settled, and work resumed. The prospects for the building trade are now very good and the workmen are satisfied by the improvement in wages they have obtained. Money is cheap and will remain so during 1911.

Business in plates and sheets was good during the whole year, due to the fact that the ship building yards had plenty of work. Evidently, many orders for new steamships have come to Germany during 1910, instead of going to England, where labor troubles were in evidence. Prices have been satisfactory all along and show a further tendency to advance. The best year's business was in wire, probably because this trade is the best organized. All wire makers are joined in a selling pool and prices and orders have been so good that the annual reports of the wire mills in Germany show excellent results.

The tube market, previously as good as the wire market, had a collapse, because the selling syndicate broke down in June; the agreement was not renewed. Keen competition then took place, and as yet there is little prospect for improvement.

The increase of consumption of German iron and steel is not so much due to the inland as to the export trade. All of the syndicates and selling combinations have done their utmost during 1910 to cultivate the export business and they are satisfied by the progress they have made on the world's market. The fear of an American invasion of the European markets has been dispelled. This fear was so great in 1908 that America was rather the barometer for the iron and steel market, but today we go our own way. A number of smaller non-mixed works have been joined with the great mixed works, and this movement will make further progress in the future. The condi-

tions for the small non-mixed works are getting most difficult as the great works which dispose of their own coal, coke and ore, take up the manufacturing of the finished materials. In a few years, it is believed, the last non-mixed works will have disappeared and we shall have then only six or eight great companies. The non-mixed coal mines show a great inclination to join with the large iron and steel works.

The iron and steel market in 1911 and even the first half of 1912, will be governed by the preparations which every company is making in the event that the Stahlwerksverband, which will end July 1, 1912, will not be renewed. Every group is busy building up its organization and its works and is making itself independent and strong for the fight, which may come in the middle of 1912, provided the Stahlwerksverband is not renewed. As the costs of producing iron in the southwest of Germany are about 10 marks to 12 marks ($2.50 to $3) per ton cheaper than anywhere else, a number of big Westfalian ironmasters are establishing branch works in Lorraine and not less than 25 blast furnaces are now under construction. Westfalia will, in the future, go in more for making quality material, and Lorraine will be the producer of quantity.

Iron and Steel Developments in Colorado

BY A STAFF CORRESPONDENT.

When considered from a financial standpoint, Denver, Colo., occupies a position that is unique in many ways. In its fifty-first year, the city has a population of 225,000 and is the capital and commercial metropolis of the Rocky mountain region. Many people who have not visited Denver believe that it is situated in the mountains. The city is actually located 12 miles east of the foothills of the Rocky mountains, at the junction of the Platte river and Cherry creek, and has an altitude of 1 mile above sea level.

Founded by gold diggers, the city has grown in half a century far beyond the wildest dreams of the most imaginative of the early settlers, until today it stands as the leading city in a state whose natural resources are prominent among the great resources of the west. Denver reaches about 2,000,000 people in Colorado and the surrounding country. Agricultural machinery, structural steel and irrigation machinery are the great items in the jobbing trade in iron and steel.

During the past year and a half, many large and substantial business blocks have been erected, totaling approximately $5,500,000. Structural steel and building materials have been the largest items in contracts let recently. Nearly all the structural steel has gone into office buildings rather than shops and factory buildings. The First National Bank building, 12 stories; Denver Gas & Electric, 10 stories; Metropolitan, six stories; Foster, 12 stories; Central National Bank, eight stories; Daniel Fisher, 23 stories; Shubert theater, six stories; Denver City Tramway, 600 feet long, and the government postoffice, costing a million and a half, are representative of the building of business buildings during the past year. After such a building pace for some time past, the outlook for the new year indicates a decided let-up in the erection of business blocks and buildings. The year will be largely devoted to finishing and completing the buildings already under construction.

Outside of Denver, two items stand out prominently, the sale and use of mining machinery and the consumption of structural steel in mine buildings. Irrigation projects bring in a considerable tonnage of steel. Through Denver is handled a major portion of all material used in the erection of coal handling plants, mine buildings, mine conveyors, irrigation power plants and pumping stations, pipe lines and electrical equipment.

For the past two years there has been comparatively little activity in any of the various mining sections. The demand for product has been lower than previously, and as nearly all the large plants are fully equipped, there has been little new construction work. It has been a period of making good and the large operator as well as the small one has economized and curtailed expenses in every possible way. In the Cripple Creek district, some 200,000,000 tons of ore will be available, as soon as the large drainage tunnel just completed has had an opportunity to drain out the excessive quantities of water that have for some years prevented all extensive operations. No large mills have been built for some time. The Colorado School of Mines, at Golden, 12 miles from Denver, is erecting and equipping what is probably the most complete mill for educational purposes in the United States.

Mining machinery is the only iron or steel product to be manufactured extensively in Denver. Rock drills and hoisting machinery put out by the Denver Rock Drill Co. and the Denver Engineering Co. supply a large portion of the trade throughout the entire western section. Very little machinery of any other character is attempted. Practically all the foundries in Denver are jobbing foundries, employing a limited number of men. A large percentage of the machinery sold is handled through eastern houses.

In the production of iron and steel products, Colorado and Pueblo, Colo., together with Denver, occupy one of the strategical points in the United States, west of the Mississippi. The Colorado Fuel & Iron Co., of Denver, whose plant and works are located at Pueblo, is a producer for a considerable portion of the United States, west and south of the Missouri river, and out to and including the Pacific coast. The history and development of the company is that of a pioneer in the manufacture of iron and steel in the west. In connection with the steel works, the company operates 23 producing coal mines, which supply about half the domestic and fuel coal used in Denver and the surrounding territory. Some 5,000 tons of coal and 3,000 tons of coke are produced daily and over 21,000 tons of coal are handled daily. It is a notable fact that miners are paid on a considerable higher scale than in the east. Coal miners, working on a tonnage basis, average $3.66 a day with a minimum of about $3 and a maximum of about $4.30 a day. Nearly all the miners are non-union.

During the year 1909 and 1910, ending June 30, 1910, the Colorado Fuel & Iron Co.'s total production of coal was 4,722,832 tons, which was 15 per cent greater than the production of

the previous year. Of this amount, 3,100,000 tons was sold in the form of coke and coal and 1,622,000 tons was used in the operation of the steel plants and works of the company. During the fall and winter of 1909 and 1910, a shortage of cars retarded operations, but the demand was such that for the greater part of the year, it was up to the capacity of the mines. During August and September, 1910, the shortage of cars again interfered considerably with mining operations, and it is estimated that production was cut down some 50,000 tons a day.

The rail mills of the Colorado Fuel & Iron Co. have been running at full capacity for the past year, the demand for rails being particularly good. A considerable tonnage for wire and wire products, including nails and spikes, has been worked up in the past three years. At present the wire and nail mills are running about 60 per cent of their capacity.

During the last three years, since L. M. Bowers, representing the Rockefeller interests, has been actively associated with the Colorado Fuel & Iron Co., considerable progress has been made and has witnessed the establishment of the company on a firm financial and business basis. No large extensions have been made on the plant proper, but considerable activity and much development work in stripping and mining have been done on the properties owned by the company. Better methods of handling the ore at the mines and in transit have materially lowered the cost of mining. By pursuing the policy that "Quality is First," the company has built up a reputation and a business during the past three years that is rapidly bringing it into first rank as a producer for the western part of the United States.

The Spanish Iron Ore Supply

Although Spain is a great producer of iron ore, the industry, according to *Daily Consular and Trade Reports*, seems to be stationary. The output in 1909 was about the same as that of 1899, while the other leading producers have been increasing their output by rapid strides. The Spanish output for 1909 was 9,384,634 tons. In the same year the United States produced 53,882,415 tons; Germany, 27,500,000 tons; Great Britain, 15,450,000 tons and France, 12,325,000 tons. The reason for Spain's poor showing of late is the growing scarcity of ore in the Biscayan zone, from which more than one-third of Spain's entire output comes, and to the non-exploitation of mines in more recently discovered ore districts, owing in many cases to the want of adequate transportation facilities.

Places of Production and Export.

In 1909, 3,871,927 tons were mined in the province of Biscay. Of this, 3,297,414 tons were exported, 44,138 tons were consumed in home ports, and 530,375 tons by local iron and steel works. The provinces of Guipuzcoa and Navarre export yearly 20,000 to 30,000 tons of ore by rail to France, through the station of Irun, and about 75,000 tons by water to England and Germany from the port of Pasajes. From the province of Santander via Santander and Castro-Urdiales, 800,000 tons are exported annually, the greater part of which contains slightly more phosphorus than the Biscayan and Guipuzcoan ores, which are from 0.02 to 0.07 per cent phosphoric.

Farther to the west, along the northern coast, are the ports of Rivadesella, San Esteban, Ribadeo, Vivero, and Corunna, whose exports amount annually to 400,000 tons of phosphoric ores, containing from 0.75 to 1.50 per cent of that element. Practically all the ore from southern Spain, 3,500,000 tons, is non-phosphoric, and thus adaptable for the manufacture of Bessemer steel.

Opening of New Mines.

The mines most recently opened are located in the Province of Teruel, where a railroad 127 miles in length was completed in 1907 to afford transportation for ore from the mines at Ojos-negros to the port of Sagunto. The production of these mines in the year 1909 was over 400,000 tons, which has greatly increased during the present year. The extraction will, it is thought, reach 1,000,000 tons in 1911.

It is to these new mines that Spain must look if she would retain her present place as an iron ore producer. It is hoped that recently discovered fields in the Provinces of Lugo, Oviedo, Leon, Teruel, and Seville will soon be opened up and, through them, within four or five years, a new annual supply of 1,500,000 to 2,000,000 tons will be obtained; but it is also calculated that during this time the present output will diminish in about the same ratio, so that the total production of the country in five years' time will be very little greater than at present. Judging from the reserve supply, as yet untouched in many provinces, the Spanish output will be able to retain its present place for many years.

Spain's Supply of Iron Ore.

The following statement, based upon recently published reports of eminent engineers, shows the known deposits of iron ore in the Iberian Peninsula, in tons: Biscay, 70,000,000; Guipuzcoa and Navarre, 10,000,000; Santander, 25,000,000; Oviedo, 55,000,000; Lugo, 65,000,000; Leon, 150,000,000; Estremadura, Segovia, etc., 10,000,000; Huelva, not counting sulphurous deposits, 10,000,000; Seville, 35,000,000; Malaga and Granada, 25,000,000; Almeria, 25,000,000; Murcia, 15,000,000; Teruel and Guadalajara, 135,000,000; Ciudad Real, 10,000,000; Catalonia, 10,000,000; Aragon, 40,000,000; Logrono, Burgos, Soria, etc., 20,000,000; deposits in Portugal, 15,000,000; total deposits in Spain, 710,000,000; deposits in Portugal, 15,000,000; grand total in the Iberian Peninsula, 725,000,000 tons.

Exhaustion of Biscayan Mines.

If the present rate of export of Biscayan ore continues, it is calculated that the reserve supply will become exhausted in about 18 years, but as the exports tend to decrease the supply will probably last at least 30 years.

Bilbao, the capital of Biscay, is the chief center of exportation. Over 3,000,000 tons are shipped annually from this port to England and Germany, via Rotterdam. The other noteworthy ports of shipment are Santander, Seville, and Almeria. Many cargoes of ore are now shipped to Philadelphia from Sagunto. This movement approached 200,000 tons in 1910.

The average prices for each year beginning with 1906 and ending with 1910, for calcined, Biscayan ore, f. o. b. Bilbao, were $3.76, $4.24, $3.15, $3.76, and $3.88 respectively. This ore when crude contains 56 per cent of iron and when dried contains 57 per cent. The corresponding prices for "Rubio," inferior grade ore, were $2.42 to $2.67, $2.91 to $3.15, $2.18 to $2.30, $2.67 to $3.15, and $2.79 to $3.27. The latter ore contains 46 per cent of iron when mined and 50 per cent when dried.

Southern Pig Iron's Steady Decline in Price

Presented a Strong Contrast With the Previous Year—Prices Strike Bottom and Production is Curtailed Sharply

By F. R. Lindsley.

As contrasted with the year of 1909, the movement in prices of pig iron was just reversed, as instead of starting in January at a low level and gradually moving upward through the year, as was the case in 1909, it opened at $14, the maximum figure, and gradually and steadily declined until August, when the low point was reached, of $11 for southern and $14 for northern, at furnace, which have been the prevailing quotations up to the present time.

The month of January, 1910, opened with a tendency toward firmness, that gradually developed under increased inquiry. This movement, however, had no effect on prices, yet was one of the features of the situation that indicated strength. Several of the large pipe makers at this time began to figure on large blocks of iron, particularly low grades, but were unable to secure full requirements, as stocks in low grades were limited to comparatively small quantities, as has been the case throughout the entire 12 months. Labor difficulties were reported, and as there was a shortage of molders, it was said that the melt was considerably decreased.

With the opening of February, there were some indications that softening influences were at work, particularly on deliveries on contract after July 1. Up to this time, quotations for this delivery appeared to be fairly strong on a $14.50 basis for southern, but it soon became evident that this price would not hold, and that producers were willing to shade it 50 cents on desirable business. Steel-making industries were quite active, and had large inquiries in the market for future needs. During the closing days of the month, some resale iron was placed upon the market at the low figure of $13 for spot delivery. This in conjunction with other disappointing features, had its effect upon ruling quotations, and the result was that the price of southern iron dropped to $13.50, Birmingham, and was weak at that figure.

Further Weakness.

March opened in a manner that indicated still further weakness. Concessions were heard on every hand, and, while some effort was made to hold quotations, the general trend was unmistakably downward, and they gradually declined. About the middle of the month, it became evident that prices had dropped to $13 for southern and $16.50 for northern. At this time, statistics indicated that producers both north and south were piling iron and had a large tonnage on yards, showing that production was still far in excess of consumption, and that something would have to be done to maintain prices. Efforts of producers, however, were unsuccessful and the close of the month recorded a further drop of 50 cents with market conditions unsettled and weak.

Reports received in April for the preceding month continued to show an over-production, and a number of furnace interests were considering the advisability of blowing out. General business conditions continued disappointing and it became less difficult to shade the price of iron. It now became an easy matter to obtain southern for $12.50 and northern at $16, Ironton, with further concessions obtainable on quick shipment contracts. The estimated consumption of southern iron at this time was at the rate of from 70 to 75 per cent of normal, with production in Alabama showing an increase of 10,000 tons, as compared with February. Conditions gradually assumed a less promising aspect and by the middle of the month the price on southern foundry grades went to $12 with little business in sight.

Monthly Average Prices of No. 2 Southern and Gray Forge at Cincinnati in 1910.

Date, 1910—	Southern No. 2 Foundry, Birmingham.	Gray Forge, Cincinnati.
January average	$14.00	$16.50
February average	13.88	16.38
March average	13.00	15.75
April average	12.12	14.88
May average	11.81	14.56
June average	11.60	14.35
July average	11.38	14.12
August average	11.00	13.75
September average	11.00	13.75
October average	11.00	13.75
November average	11.00	13.75
December average	11.00	13.75

The first week of May saw the price of northern go 50 cents lower, making the ruling quotation $15.50, Ironton. Southern prices, while on practically the same basis as at the close of April, were weak and the market was sluggish, with little inquiry pending. Statistics for the preceding month indicated that curtailment in production had started in earnest by the blowing out of a number of stacks. Throughout the entire month, it was quite evident that producers and consumers were experiencing considerable difficulty in getting together and the result was another drop of 25 cents in the price of southern iron, quotations now being $11.75, Birmingham, and very weak at that figure. The situation in the east was quite a little stronger, and inquiries for 20,000 to 30,000 tons were pending with cast iron pipe interests placing orders for about 15,000 tons of gray forge.

No change in conditions was noticeable in the early days of June and sales were of such a character and of such minor importance that it became difficult to fully determine what the ruling quotations actually were. The action taken by the government at this time against the proposition of the railroads to raise rates, was not without its effect and a further decline in prices was expected. The Iron Trade Review editorially, in the issue of June 2, said: "The action of the government against the proposed increase in railroad rates, coming at a time when the iron and steel industry is showing slow improvement, causes some anxiety. The effect is doubtful, as railroads which have been buying more freely may curtail their purchases."

That this prediction has been verified is perhaps unnecessary to state and the various tool and steel interests are still waiting for this general buying movement to materialize.

During the next week or two, it became again necessary to revise the schedule, and quote southern foundry on an $11.50 basis and northern at $14.75. These figures, however, it was stated, would apply only on third quarter business, but it was very evident that producers would, if necessary, strain a point and carry the

contract through the remainder of the year on the same basis.

July opened in a listless manner, with very little inquiry pending. Several large interests at this time began to figure on next year's requirements and made offers at prices that were practically prohibitive, and which received slight consideration from producers. One of the large plow concerns was unable to secure its quota at prices that were satisfactory and withdrew indefinitely from the market. Statistics continued to show an excess production, the average for June being but 238 tons less than for May. The list of active stacks showed a loss of eight with five stacks blown out since July 1, with indications that others would soon be added to the number. In this connection it may be interesting to state that out of a total of 36 stacks in Alabama, 28 of which ordinarily run, since the other eight are not available, there were but 13 stacks in blast making foundry iron, and in Tennessee out of a possible 15 stacks running on foundry iron, there were but nine in blast. It was again necessary to change quotations and make the price of southern iron $11. The most important transaction in this territory was the sale of 3,500 tons of Bessemer and 11,000 tons of basic, all taken by a local consumer.

Sales Small.

August started in with very little life to the market, and sales were small and of an unsatisfactory character. Prices apparently had reached low levels, and there was an evident disposition on the part of the furnaces not to make any further concessions, as the general expression of those in a position to know was that the line of profitable production had now been reached, and to go lower would mean a distinct loss to the furnaces. From future events, it would appear that this conclusion was timely and well founded, as the records for the four remaining months of the year clearly indicate that established quotations did not go below this figure, and will likely be the basis of computation for the beginning of 1911. Quite a number of feelers and bonafide inquiry developed at this time in regard to next year's requirements, but consumers apparently were in no hurry to enter into future contracts. Quite a little tonnage, however, was sold on a strictly cash basis, with the proviso that the furnaces would store and hold the iron until the following year. Cast iron pipe interests continued to absorb the greater portion of the lower grades, yet were unable to secure sufficient tonnage to meet the requirements of trade, which at that period was approximately normal. Further purchases aggregating about 30,000 tons were made by these interests, and as one of the large plow concerns had bought about 40,000 tons at about the same time, it was thought that the effect on the market would be beneficial and that in a measure the atmosphere would be somewhat cleared. The smaller buyers, however, who were expected to follow in the wake of these larger sales, failed to come to time, and the result was that the market again became quiet and unresponsive. The increased demand for cast iron pipe, incident to municipal improvements that were under way, again made itself felt, and the leading interest secured a large block of various grades that was estimated as ranging between 50,000 and 60,000 tons.

October.

October brought little relief to the situation, and while there were a number of inquiries for various grades, general conditions were so unsatisfactory that the majority of consumers merely bought what was required for early use. Owing to the unsettled condition of the market at this time, several large inquiries that had been pending for some weeks were indefinitely withdrawn.

The month of November opened with a little better demand for basic, and several large inquiries were figured upon by local agencies. Foundry grades were also slightly more active, and there was a fair tonnage sold, mostly, however, in small lots. Just when the time appeared to be ripe for conditions to show a gradual movement upward, the results of the election were made known, with the uncertainties incident thereto, and the market gradually drifted back to its former state.

Close of the Year.

December was a close follower of its predecessor, and the weakness in market conditions continued throughout the entire month. Just what the future may have in store, it is unsafe to predict, yet there are one or two strong features that present themselves as active agents in the settlement of the question. First and probably the most important is the current report that quite a number of both northern and southern stacks will be blown out in the immediate future, which it is hoped will curtail production to such an extent as to place it more nearly on a parity with consumption. Then, if the question of changing the tariff is allowed to lie dormant for a while, with crops the greatest in the history of the country, it is rather difficult to conceive of anything that might arise to disturb industrial conditions.

Defects in Alloys

At the recent meeting of the Institute of Metals, a paper treating of the diseases of non-ferrous metals was read by Cecil H. Desch. It was pointed out that the study of the properties of the softer metals had not kept pace with that of iron and steel.

The manufacturer of alloys who finds it necessary to produce a new alloy for special purposes, or to modify some known mixture for new requirements, has generally to grope in the dark. Repeated trial is the only recourse.

Mr. Desch referred to some of the common defects in alloys, as follows:

Sponginess is caused by gases dissolved in the molten metal being released at the moment of solidification. It is aggravated by over-heating and may be remedied by re-melting and pouring at the proper temperature.

Brittleness may be caused by oxides or dross from insufficient care in pouring, or by over-heating causing burning, as in the case of zinc alloys. Oxides of various metals differ in their ability to separate themselves from the liquid and rise to the surface, and various deoxidizers are used to facilitate their removal in the form of slag.

Inequalities of Composition.

Defects due to inequalities of composition arise from the difficulty in mixing the ingredients uniformly. The usual cause is difference in specific gravity, aluminum tending to float and lead to sink. Certain metals, particularly aluminum, have the property of becoming enclosed in a film of oxide as soon as molten, while others behave like oil and water, and must be stirred to an emulsion and then carefully cooled to prevent separation. With alloys of tin and antimony, or mixtures containing them, crystals of tin and antimony form and float upwards. This tendency is overcome by rapid chilling.

Excessively coarse structure is due to casting at too high a temperature. As the strength of an alloy depends on the size and the degree of interlocking of neighboring crystals, and as these in turn depend on the cooling temperature and the degree of chilling, the whole problem is of a complex nature.

The Non-Ferrous Metal Markets in 1910

Review of the Copper, Tin, Lead and Spelter Markets With Estimates of Production and Price Fluctuations

By J. Chalmers Warwick.

The most serious question that the copper trade was engaged with at the opening of the year, was how could production be restricted to a point where consumption could overtake it and reduce the enormous world's surplus of refined copper, which had risen to about 400,000,000 pounds? The movement which started late in 1909 to consolidate the important producing interests under a $1,000,000,000 holding company, with that purpose in view, had apparently been abandoned because of the activity of the national government against combinations of industrial and railroad corporations. The market was threatened with a further accumulation of stocks, notwithstanding deliveries were going into domestic and foreign consumption, at a rate that indicated an unprecedented total for 1910, and the price of the metal began to decline. Early in the year information was given out that leading interests were working on a substitute plan to curb production, which

THE VISIBLE SUPPLY OF COPPER IN THE UNITED STATES, ENGLAND AND FRANCE, IN 1910.

1910.	United States.	England and France.	Total.
Jan. 1....	141,766,111	244,204,800	385,970,911
Feb. 1....	98,463,339	248,236,800	346,700,139
Mar. 1...	107,187,992	254,150,400	361,338,392
Apl. 1....	123,824,872	249,625,600	373,450,472
May 1....	141,984,159	246,870,400	388,854,559
June 1...	160,425,973	239,142,400	399,568,373
July 1...	168,386,017	232,892,800	401,278,817
Aug. 1....	170,640,678	222,320,000	392,960,698
Sept. 1...	168,881,245	218,444,800	387,326,045
Oct. 1....	148,793,714	211,276,800	360,070,514
Nov. 1....	139,261,914	198,060,800	337,322,714
Dec. 1....	130,389,069	193,200,000	323,589,069

REPORTS OF THE COPPER PRODUCERS' ASSOCIATION DURING 1910.

Month.	United States production.	Deliveries, domestic.	Deliveries for export.
Year 1909.	1,405,403,056	705,051,591	680,942,620
I 1910...	116,547,287	78,158,387	81,691,672
II	112,712,493	66,618,322	37,369,518
III	120,067,467	62,844,818	40,585,767
IV	117,477,639	67,985,951	31,332,434
V	123,242,476	59,305,222	45,495,400
VI	127,219,188	53,363,196	65,895,948
VII	118,370,003	56,708,175	59,407,167
VIII	127,803,618	67,731,271	61,831,780
IX	119,519,983	64,501,018	75,106,496
X	126,469,284	67,814,172	68,186,912
XI	119,353,463	60,801,992	67,424,316

was based on the "gentlemen's agreement" idea. Putting this theory into practice became, and continued to be, the foremost factor in the market for the metal during the entire year.

A glance at the accompanying tables will show that not until the beginning of the last half of 1910 was the rising tide of combined stocks of the United States and Europe checked, or that the downward trend of the price of copper was spent. The table of prices is compiled from the closing quotations of standard copper on the New York metal exchange; and although they do not represent actual transactions, they are the official expression of the price range of the metal in the domestic market. The statistics of the world's visible stocks are based on the reports of the Copper Producers' Association, and the London fortnightly statements.

MONTHLY, HIGH, LOW AND CLOSING PRICES OF COPPER.

1910	New York, cents per lb. High.	Low.	Close.	London, £ per ton 2,240. High.	Low.	Close.
January	13.50	13.12½	13.25	61-13-9	60-7-6	60-15
February	13.25	12.95	13.00	60-6-3	58-18-9	59-10
March	13.30	12.85	12.85	60-10	57-15	57-15
April	12.87½	12.12½	12.12½	58-2-6	56-	56-
May	12.60	12.05	12.55	57-	55-7-6	56-15
June	12.52½	11.92½	11.92½	56-17-6	54-2-6	54-10
July	12.17½	11.70	12.17½	55-10	52-16-3	55-10
August	12.40	12.12½	12.30	56-7-6	55-	55-15
September	12.22½	12.05	12.15	55-15	54-15	55-5
October	12.55	12.12½	12.40	57-5	55-11-3	57-
November	12.57½	12.42½	12.45	58-2-6	57-3-9	57-5
December						

Continuous improvement in the European statistical position of the metal began in March, but it was not of a degree sufficient to offset the heavy monthly increases in domestic stocks. The steady decline in the foreign visible supply of copper indicated a strong consumptive demand abroad, however, and was an important factor in preventing a decline in prices farther than did occur. Low prices were made in all grades during July. Electrolytic sold at 12.37½c, delivered, 30 days, in the Naugautuck valley; lake at 12.62½c; and casting at 12.25c, compared with 13.87½c, 14.12½c and 12.50c on Jan. 2, 1910, respectively. At this level prominent producers withdrew from the market, while consumers encouraged by the low prices and the excellent demand became more interested in the market. A heavy buying movement started, both for domestic and foreign deliveries, and notwithstanding that the producers' agreement had failed up to that time to effect a reduction in the output, only a limited amount of the metal was offered. The result was a quick upward turn in the market that continued to the close of September.

In the meantime, consumers had supplied themselves liberally with metal and prices showed a tendency to lag. The September report of the Copper Producers' Association, published early in October, was the first to give indication of appreciable success in curtailing production, and this inspired a resumption of the advancement of prices. The report showed a decrease in production of over 8,000,000 pounds, and a decline in stocks of over 20,000,000 pounds, compared with the August statement. October and November reports showed a further net decline in rate of output and in stocks, and at the end of the latter month producers generally were asking 13c for electrolytic, delivered, 13c for lake, and 12.50c for casting, with little pressure to sell.

Manufacturers of brass goods and electrical machinery supplies and copper sheets were larger consumers of copper during 1910 than ever before. There was a noticeable lack of expansion, if not contraction, though, in the demand from wire drawing interests. The year was not a favorable one for the flotation of securities, and transportation companies which contemplated the use of electricity for motive power deferred such improvements, to a large extent, because of the poor financing period. Notwithstanding that this, the largest single source of copper consumption, was thus interfered with, estimating the twelfth month as the average of the first eleven, deliveries into domestic consumption and for export for the calendar year will exceed 1,460,000,000 pounds, and establish a new record. The official total of deliveries for 1909 was 1,385,994,211 pounds.

Production of copper will also reach a new high mark. During the first eleven months of 1910 the output of refineries, included in the producers' reports, was 1,328,782,901 pounds, mak-

ing the estimated total for the year about 1,445,000,000 pounds, compared with 1,405,403,056 pounds produced in 1909.

The year closes with the copper industry stronger statistically, both in this country and Europe, than for two years, and the outlook for continued improvement good, provided general industrial activity does not suffer a further decline during 1911. Among the developments during the year of future prospects for expansion of consumption, the following are the most prominent:

The board of directors of the Western Union Telegraph Co. declared in favor of using copper wire wherever renewals of trunk lines are necessary, and for extensions. The company has a total wire mileage of 1,382,500 miles. Of this 882,499 miles are iron wire, and will eventually be replaced with copper. The Great Northern, the New York Central, the Boston & Maine, the New York, New Haven & Hartford, and the Delaware, Lackawanna & Western railroads announced the intention to electrify congested portions of their systems, when conditions are favorable. While it is not likely that all of these announcements will develop immediate new business they are interesting because they indicate the opening of a new source of consumption, which has been long expected and which will eventually reach a large total.

MONTHLY HIGH, LOW AND CLOSING PRICES OF TIN.

	New York, cents per lb.			London, £ per ton 2,240.		
1910	High.	Low.	Close.	High.	Low.	Close.
January	33.37½	32.17½	32.42½	151-7-6	1 6-10	147-2-6
February	33.37½	32.37½	32.75	152-5	146-15	149-7
March	33.60	31.55	33.60	152-10	143-12-6	152-10
April	33.30	32.32½	32.80	151-17-6	147-10	149-12-6
May	33.37½	32.60	33.20	151-5	148-12-6	149-17-6
June	33.37½	32.50	33.37½	150-10	147-10	150-10
July	33.50	32.30	32.87½	150-2-6	147-10	149-5
August	36.02½	33.10	35.60	164-10	151-	163-
September	36.17½	34.37½	34.42½	166-	156-10	156-15
October	37.65	34.40	36.67½	170-	157-5	166-17-6
November	37.45	35.37½	37.30	170-	163-	169-15
December 15	38.70	37.92½	38.70	176-15	170-17-6	176-5

The Pig Tin Market in 1910.

While the world's consumption of pig tin during 1910 will probably be shown as the largest in the history of the industry when the full statistics have been made up, and while production has not advanced in proportion, these two fundamental factors have not been the ruling influence in the market for the metal.

Late in 1909 a London syndicate gained a strong hold on the Straits tin situation and during the entire 12 months covered by statistics up to Nov. 30, 1910, its influence had been the most potent concerning the price of tin. A comparison of the relative changes that have taken place in both the visible stocks and the value will clearly demonstrate how the natural law of supply and demand has been superseded for an extended time by artificial means, expressed in the concentrated power of a number of speculators. At the beginning of the period under discussion, the total visible stocks of tin were 20,025 tons, and the price was 31.75c per pound. Reckoned on general trade conditions these figures were considered normal. At the close of the 12 months, visible stocks were 18,875 tons, or 5.75 per cent less, and the price was 38c or 16.45 per cent higher than on Dec. 1, 1909. If the small decrease in stocks could be accepted as indicating an early dissipation of the world's surplus, the disproportion of the changes would not be conspicuous. No such fear has been expressed, however, which leaves but one legitimate reason for it, that is, a higher cost of production, which may have been caused by a scarcity of cheap labor. It could not reasonably be expected that the consuming interests would accept the latter explanation as being responsible for more than a small part of the proportion of three to one in the changes, however, and they do not. The nature of the price fluctuations alone would brand the dominating influence as a speculative one even although statistics were not considered. Fluctuations were frequent, violent and wide, lacking in almost every instance the orderly methods characteristic of conservative trade adjustments.

In view of the fact that the United States consumes above 40 per cent of all the pig tin produced and its percentage of the world's production is inconsiderable, this country's manufacturing trade has probably been the largest contributor to the syndicate profits. It will continue to be the largest, so long as the market is controlled by the foreign speculator. It is generally believed that the accumulation of tin by the syndicate has reached a high total, however, and that the next few months will offer little opportunity to reduce it in the American market, due to our unsatisfactory trade conditions. Indications favor the conclusion that the first half of 1911 will prove to be a lean business period here and that the consumptive demand on which pig tin quotations have been run up to a dizzy height will be greatly reduced. Should this conclusion prove to be accurate, history may repeat itself by recording another failure to sustain a corner in the tin market sufficiently long to successfully close it.

The hand of combined *indicia* has been raised in warning for some time, and only the most venturesome and those under stress of immediate need have entered the market. To the conservative business man this condition implies but one eventual result; that, by stifling consumption with high cost of raw material or by over stimulating production with an artificial value, an uncontrollable surplus of tin will develop and force prices back to a natural level. Just how long the crisis can be postponed depends upon the financial resources of the manipulators.

Domestic Consumption.

Domestic consumption of tin will not fall very much, if any, below 45,000 tons for the calender year, and the world's production may not exceed from the Straits. The chief consumer in this country is the United States Steel Corporation, and this interest exercised a restraining influence on prices during the first half of the year. Of late months, however, it has apparently been an unimportant factor in this respect. The European consumption was good, and the net change in the world's visible will probably be a decrease of a few thousand tons. The total arrivals of tin at Atlantic ports from Jan. 1 to Nov. 30, 1910, aggregate 41,543 tons, against 37,775 tons for a similar period in 1909. The deliveries into domestic consumption for the same period were 41,750 tons and 38,300 tons respectively. The following table shows the comparative classified tin imports for 1910 and 1909:

CLASSIFICATION OF TIN IMPORTS FROM JAN. 1 TO NOV. 30.

	1910.	1909.
Straits	34,015	33,277
Australian	329	490
Banca and Billiton	609	347
English	3,282	1,890
Chinese	907	120
Sundries	2,401	1,651
Total tons	41,543	37,775

The large deliveries indicate a satisfactory condition of the tin trade throughout the year, though as stated, there are signs of a sympathetic weakening without our general unfavorable trade conditions as the close of 1910.

The accompanying table of prices, compiled from closing quotations of the New York metal exchange, gives the monthly high, low and closing prices of tin for the first eleven months of the year.

Due to the meager available statistics concerning the production and consumption of pig lead, the market for this metal is filled with considerable mystery. In view of this fact discussion of the lead situation during 1910 will be based on general trade views rather than on fragmentary figures.

At the beginning of the year trade estimates of surplus stocks placed the total sufficiently high to make a safe margin for ordinary expansion of consumption, even although some contraction should take place in production. If the range of prices has been a true indication of the supply and demand during the first 11 months of 1910, the trade estimates must have approximated the actual conditions very closely. The extremes of the accompanying table, which is compiled from the daily quotations furnished by the New York metal exchange, show that the metal fluctuated between 4.70c and 4.30c from January to May, and between 4.30c and 4.50c up to Nov. 30.

MONTHLY HIGH, LOW AND CLOSING PRICES OF PIG LEAD.

	New York, cents per lb.			London, £ per ton 2,240.		
1910	High.	Low.	Close.	High.	Low.	Close.
January	4.70	4.65	4.70	13-16-3	13-10	13-10
February	4.70	4.47½	4.65	13-8-9	13-3-9	13-3-9
March	4.65	4.45	4.45	13-5	12-18-9	12-18-9
April	4.45	4.37½	4.37½	12-17-6	12-10	12-10
May	4.47½	4.30	4.45	12-15	12-6-3	12-10
June	4.47½	4.42½	4.47½	12-15	12-10	12-11-3
July	4.50	4.40	4.47½	12-12-6	12-8-9	12-10
August	4.50	4.45	4.45	12-11-9	12-8-9	12-11-3
September	4.45	4.40	4.45	12-15	12-8-9	12-13-9
October	4.47½	4.47½	4.45	13-6-3	12-16-3	13-5
November	4.50	4.45	4.50	13-7-6	13-2-6	13-3-9
December 15	4.50	4.50	4.50	13-3-9	13-1-3	13-3-9

During the 11 months the demand on the surface varied from good to indifferent. It did not, however, at any time reflect a full realization of the optimistic views held by the trade generally early in the year.

Manufacturers of sheet lead and lead pipe were active buyers, but users of corroding lead were notably not interested in the market throughout the year. In verification of this statement, we cite the reduction of the dividend on the stock of the National Lead Co. from 5 per cent to 3 per cent at the mid-year meeting of the company's directors, because of the declining business. The National company is the largest individual manufacturer of lead products and its earnings furnish a good indication of general conditions prevailing in the chemical branch of the lead trade. The American Smelting & Refining Co. was the dominating influence on the selling side of the market, although in some instances during the first six months there were indications that independent interests were underselling it. During the last half of the year the latter interests were from 2½ to 5 points above in their asking price. It is doubtful, however, if these variations denote a serious waning of the combination's grip on the lead situation.

Production of lead was interfered with to some extent by labor troubles during the year, and it is probable that the government statistics will show some reduction in the output of 1910, compared with 1909. These figures will not be available for several months after the year closes. It may be said, however, on reasonable grounds, that stocks did not increase between Jan. 1 and Dec. 31, 1910.

The decline in the price of spelter during the first six months of 1910, is held to be more a result of general business sentiment than of fundamental weakness in the industry. In fact the two features, consumption and production, which ordinarily rule in establishing values, favored an advance in price rather than a decline. At the beginning of the year, surplus stocks were estimated at about 12,000 tons, and because of the failing supply of natural gas in the Kansas smelting district a steady decline in production was foretold. In addition to this, activity in spelter consuming industries indicated a good demand for the metal, and at the end of the first quarter most of the important producers were sold up from two to four months ahead. These facts, however, did not operate as a check to the decline, until the price had dropped from 6.27½c in January, to 5.30c in May, on the New York metal exchange, as shown in the accompanying price table.

THE MONTHLY HIGH, LOW AND CLOSING PRICE OF SPELTER.

	New York, cents per lb.			London, £ per ton 2,240.		
1910	High.	Low.	Close.	High.	Low.	Close.
January	6.27½	6.12½	6.12½	23-7-6	23-2-6	23-5
February	6.12½	5.47½	5.75	23-5	23-2-6	23-2-6
March	5.82½	5.60	5.60	23-2-6	23-	23-
April	5.60	5.30	5.30	23-	22-	22-
May	5.55	5.30	5.55	22-7-6	21-15	22-7-6
June	5.55	5.32½	5.55	22-7-6	22-	22-5
July	5.55	5.32½	5.55	22-12-6	22-5	22-12-6
August	5.55	5.32½	5.42½	23-	22-12-6	22-15
September	5.55	5.42½	5.55	23-10	22-15	23-10
October	5.80	5.55	5.80	24-2-6	23-10	24-2-6
November	5.92½	5.85	5.90	24-2-6	24-	24-
December 15	5.96	5.70	5.70	24-2-6	24-	23-17-6

When the price reached 5.20c in New York, producers withdrew, claiming that the small margin of profit was not warranted by actual conditions. From that point down to 4.90c only resale lots, which mostly represented speculative holdings, were offered in the open market, and as these did not aggregate a large total the floating supply was quickly exhausted. During the few days the market hesitated around the low level a fair volume of inquiries accumulated, and when these failed to excite offerings, bidding became active and advanced prices materially. By Nov. 30, spelter was again selling above 6c in New York, and at 5.90c in St. Louis. General trade began to wane early in December, however, which discouraged further buying by consumers, and the market receded to 5.70c in New York, and 5.50c in St. Louis.

It was generally believed at the end of November, that the small surplus with which the year started, had been consumed and that if any balance of 1910 production was to be carried over the end of the year, it would be a result of opperations in December. With only about 60,000 retorts being actively operated, out of the 87,646 belonging to plants that make prime western spelter, the probabilities certainly do not favor the accumulation of a large balance, either this year, or in 1911.

The foreign consumption of spelter was greater than ever before, and has caused an actual shortage in the European markets. Under the restrictive terms of the convention early relief from that condition cannot be looked for, and with a continuation of the good foreign demand, should our consumption fall to a very low point spelter might be exported profitably in a fair volume.

The recent discovery of calamine ore in the Leadville district aroused considerable interest throughout the spelter trade. It will probably be found when the enthusiasm which always accompanies the early news of important discoveries has cooled down that the facts will not measure up to dimensions given originally. The estimated ore body of 1,215,000 tons, averaging 37½ per cent metal, and valued at approximately $20,000,000, may be far too great. But the newly discovered deposits are unquestionably of considerable importance, as they are the only conspicuous addition made to the known zinc ore reserves for a decade or more.

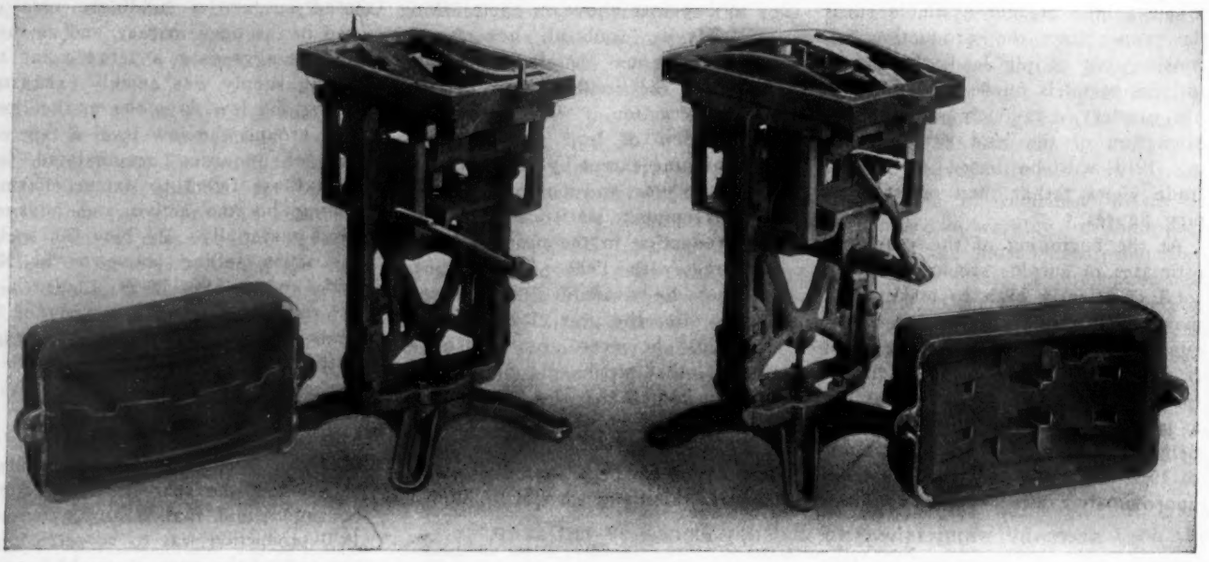


FIG. 1—STRIPPING PLATE MACHINES FITTED WITH PATTERNS FOR MOLDING STREET CAR BRAKE SHOES.

Stripping Plate and Turn-Over Draw Molding Machines

In Figs. 1 to 4 are shown two types of molding machines of stripping plate and turn-over draw designs, respectively, manufactured by the Edward A. Pridmore Co., Chicago. A pair of stripping plate machines, fitted with patterns for molding street car brake shoes, is shown in Fig. 1. The yoke of this stripping plate machine, which carries the pattern, travels in one set each of upper and lower adjustable guideways. This insures an absolutely true pattern draw. The draw of the machine, which at its maximum is 5½ inches, can be instantly adjusted to the amount required for the pattern to be molded. This stripping plate type of machine is made in 14 different sizes, so constructed that each size is adjustable for use in a large variety of flasks. It is very low to facilitate ramming, is exceedingly substantial and rigid in construction, the upper and lower frames, to which both sets of ways are attached, being cast in one. The parting of the brake shoe pattern mounted on this pair of machines, is on the curve of the shoe. It is formed by building-up parting pieces on one of the stripping plates and making corresponding recesses or depressions on the other plate. It is claimed that this method is more economical than making curved stripping plates to conform with the parting line of the pattern. The necessity of using a cut flask is also thereby obviated.

In Figs. 2, 3 and 4 is shown the molding machine of the turn-over draw type. In Fig. 4 the machine is shown fitted with the pattern ready to receive the flask. In Fig. 2 is shown the mold rammed with the bottom board and flask clamped to the pattern carrying frame. In Fig. 3 the mold has been turned over onto the receiving device ready for the pattern to be drawn. These machines are made to be operated by hand or power, depending upon the size of the work to be molded. There is practically no limit to the amount of pattern draw which can be secured and stock sizes are made with draws of from 6 to 14 inches. The pattern carrying frame operates on parallel uprights, which are set and finished to such a degree of accuracy as to insure an absolutely true and even pattern draw. Adjustable counter-balancing devices operate automatically in conjunction with all work-

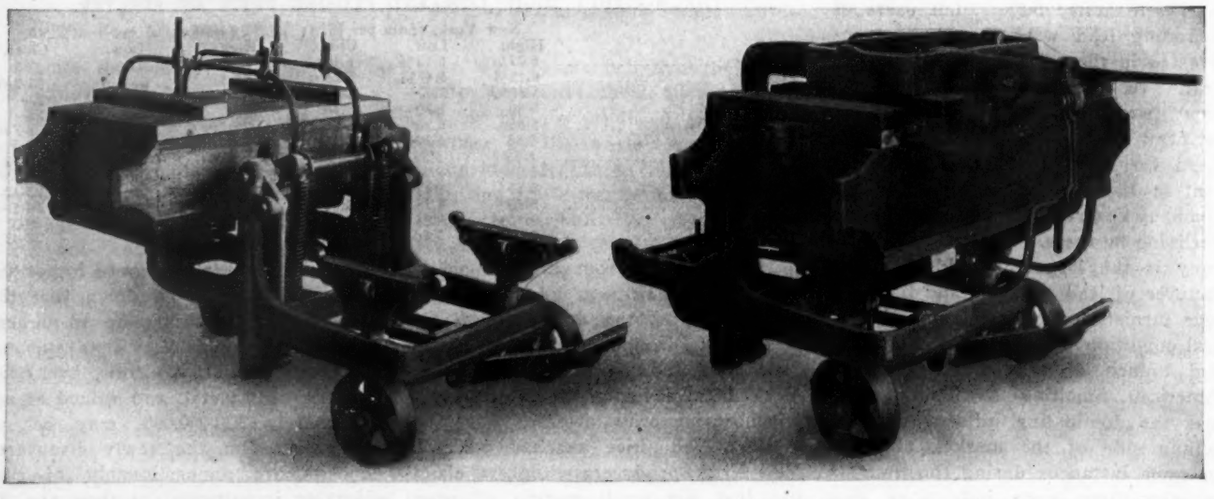


FIG. 2—TURN-OVER DRAW MACHINE, SHOWING THE MOLD CLAMPED WITH THE BOTTOM BOARD TO THE PATTERN FRAME.

FIG. 3—MOLD TURNED OVER ONTO RECEIVING DEVICE READY FOR THE PATTERN TO BE DRAWN.

ing parts, so that the heaviest mold can be turned over and the pattern withdrawn from the mold with the utmost facility. The flask receiving device is adjustable in every direction. The flask rods are fitted with adjusting screws so

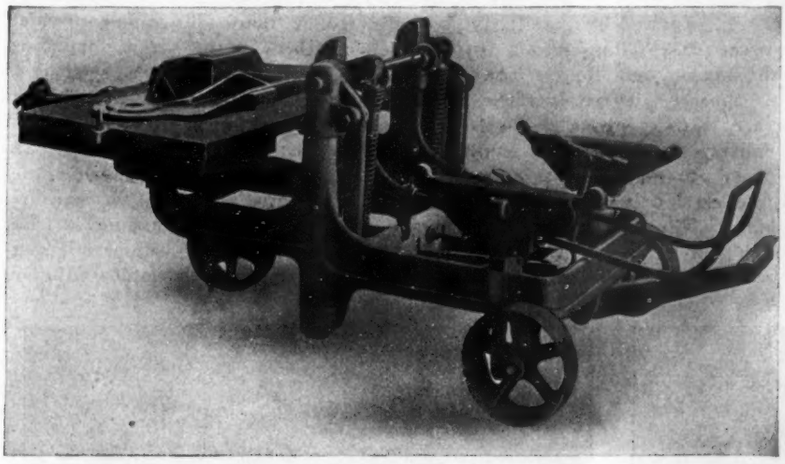


FIG. 4—TURN-OVER DRAW MACHINE FITTED WITH PATTERN READY TO RECEIVE THE FLASK.

that flasks of various depths can be used on the same machine without "blocking-up." All working parts are away from the sand and are carefully protected from dust. Several sizes of these machines have been designed for molding cores.

Melting Furnace for Pouring Metal Direct Into Molds

In the accompanying illustrations are shown views of a melting furnace equipped with a tilting device which permits of pouring the metal direct from the furnace into the molds or chills, in place of first pouring it into a heated ladle or crucible from which the metal is subsequently cast into molds. The second handling of the metal is frequently objectionable, as it loses considerable heat when poured into crucibles or ladles, and for this reason must be raised to a temperature considerably higher than when poured direct into the molds without first transferring it into another vessel. When making light or intricate castings it is essential to pour the metal into molds or chills direct from the vessel in which it is melted, owing to the fact that it is liable to chill, and since the introduction of automatic and other types of molding machines, the pouring of the molds has been a serious problem which has frequently curtailed the output of these machines. By pouring direct, however, the casting of the molds will be greatly facilitated. Rotary or tilting furnaces, as ordinarily built, are mounted on trunnions in such a manner which permits of the rotation of the furnace body when pouring the metal. The pouring spout of the furnace describes an arc in proportion to the rotation of the furnace. On account of the shifting movement of the pouring spout it is difficult to pour the metal direct into molds, as it is necessary to move the receptacle back and forth to catch the stream.

Realizing the economies that can be effected by a furnace from which the metal can be poured direct into the molds, the Rockwell Furnace Co., 26 Cortlandt street, New York City, has built a melting medium, shown herewith, which eliminates the ladle and pouring crucible. The metal can be melted with or without crucibles, using oil or gas fuel, and the furnace with its operating device is the invention of W. S. Quigley, vice president of this concern. This pouring problem has been solved by mounting the furnace in such a way that it tilts or revolves around its pouring spout on an axis passing transversely through the spout, thereby permitting the metal to always flow from a fixed point. The tilting of the furnace in this way permits of pouring the entire contents into an opening less than 2½ inches in diameter and at any desired speed, which can be increased or decreased by the operator, who can instantly raise, lower, or lock the furnace in any desired position. The furnace shown in Figs. 2 to 5, which has the appearance of a melting medium of the tilting crucible type (the open flame furnace not being shown, but which is handled in the same manner), is mounted on trunnions and may be revolved by hand for charging, mixing skimming and for pouring the metal into a ladle or crucible in the regular manner by the aid of the hand wheel at the side. The furnace, however, has an additional guide over each trunnion with stops, which, in the position shown in this illustration, prevent the furnace from being tilted by hand further than the special bearings into which the guides are locked when ready to pour with the pouring device.

The lifting or rotating device, shown in Fig. 1, consists of a hydraulic ram the speed of which in either direction is controlled by a hand lever shown in the foreground in Fig. 2. This lever operates a balanced valve which regulates the flow of water in the lifting cylinder. A small hydraulic pump, driven by a 2-horsepower motor, operates the hydraulic ram. This power

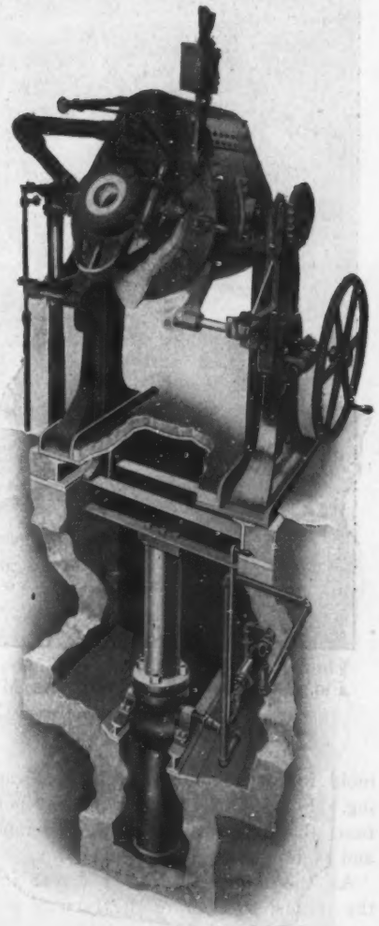


FIG. 1—METAL MELTING FURNACE, SHOWING HYDRAULIC RAM FOR TILTING.

plant is sufficient to operate from three to five furnaces and the pump may be belt-driven from a line shaft if desired. The fuel, which may be oil or gas, is conveyed to the furnace through telescopic pipes, Fig. 1, which permit the

furnace to be operated in any position. A switch and pressure controlling device are provided, which automatically maintain a uniform pressure of between 80 and 100 pounds in the tanks. The exhaust water or waste from the cylinder flows back to an open tank on which the reservoir rests, and is used repeatedly, the only loss being from evaporation. To prevent freezing, a solution of 3 pounds of calcium chloride to each gallon of water will permit it to withstand a temperature of —10 degrees Fahr., but if preferred, oil may be substituted for the water. In Fig. 3, the furnace is shown in position ready to pour the metal and in Fig. 4 the metal is being cast into a mold for an engine driver bearing casting. Fig. 5 shows another pouring position, the furnace being nearly empty, and is rotated practically half way.

As the metal is poured direct into the molds, to operate the furnace economically, the molds or chills are conveyed from the molding machine to the furnace and after being poured are carried away. This can be accomplished by placing the molds on low cars operating on tracks, or by means of an endless belt or chain conveyor. When operating by this method the molding machine operator places the mold or chill on the conveying device and as rapidly as the molds are made the flasks are carried away to the furnace to be cast. While still on the conveyor they are poured and are then delivered to the shaking-out floor.

If the castings are of such a nature that they cannot be shaken-out within a few minutes ofter pouring, an automatic trip, operated by gravity, is provided, the flask falling into a grating on the shaking-out floor. The sand passes through the grating, the castings are thrown into a dump bucket for delivery to the tumbling mill and the flasks are placed on the conveyor and are carried back to the molding machine. The sand, as it passes through the grating, falls into the hopper of a sand-mixing machine, where it is again prepared for use, or it falls into a dump bucket underneath the grating and is carried away to the point where the sand is tempered and again prepared for use. With the exception of the men employed for preparing the sand the furnace can be operated, molds made and shaken-out, by only three men. A further advantage of this continuous system is the practical elimination of the molding floors, which have been gradually increased in size with the growing efficiency of the molding machine. If the nature of the castings is such that they must remain in the flask for several hours or more before shaking-out, the poured flasks are automatically delivered to a storage floor, where, by means of a quick-acting device, they are lowered from the conveyor to the storage floor and allowed to cool. When ready to be shaken-out they are raised by this device and transferred by the trolley onto the conveyor which delivers them to the shaking-out floor.

The application of this system to brass mill casting shops provides an economical equipment for melting and casting the metal. The molds are placed on racks, which, instead of being stationary, are on a carriage and operate on a track extending in front of the furnace. This will permit casting the metal with the molds either in a vertical or slightly inclined position and will, furthermore, permit of the use of pouring strainers, or the metal can be poured direct into the molds. Rack carriages can be arranged in a pit to accommodate the various lengths of molds, as well as for tube shell and bolt and wire bar molds. Easy manipulation of the molds for taking up the shrinkage is provided for. While operating conditions are different in every foundry the furnaces, operating device and conveyor can be adapted to the requirements of almost any plant and it is claimed will effect great economies in the casting of the metal and the handling of the molds.

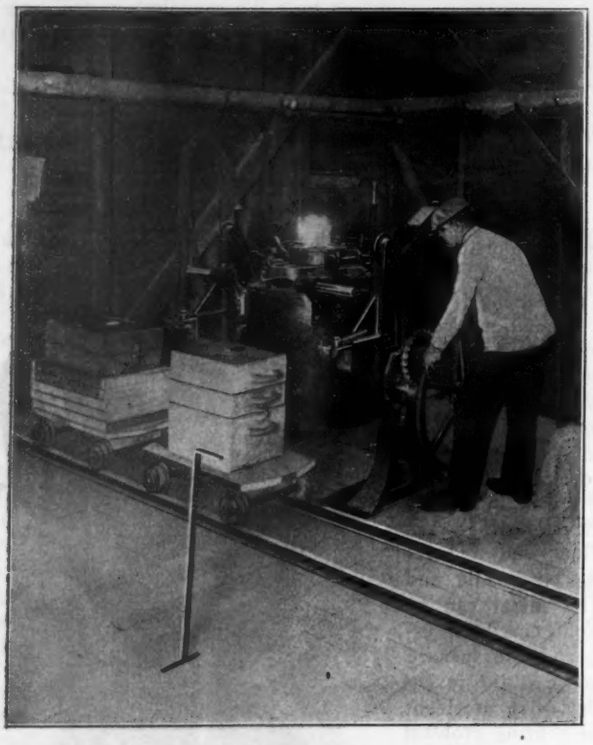


FIG. 2—PREPARING TO POUR THE METAL DIRECT FROM THE FURNACE INTO A MOLD.

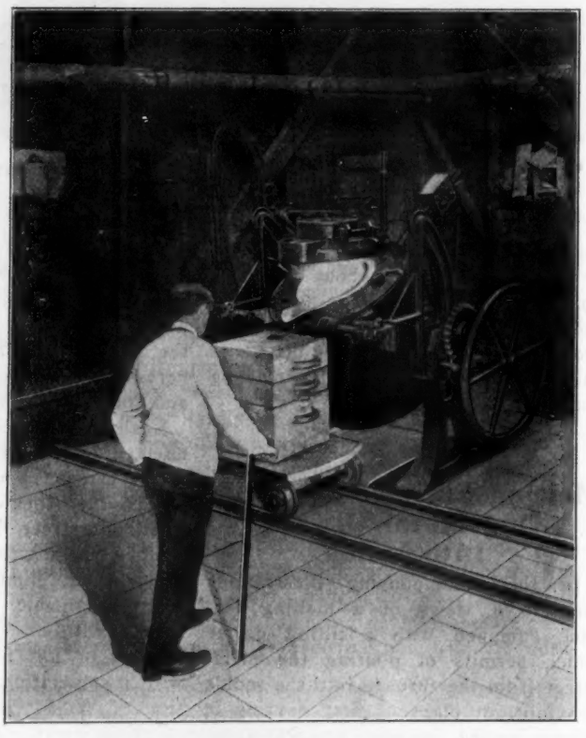


FIG. 3—THE FURNACE SLIGHTLY TILTED AT THE BEGINNING OF THE MOLD-POURING OPERATION.

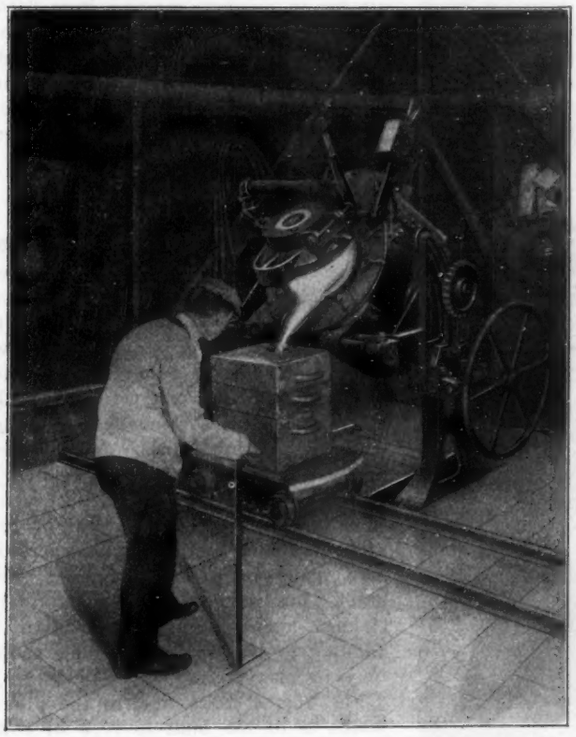


FIG. 4—POURING A MOLD; THE FURNACE IS SLIGHTLY TILTED.

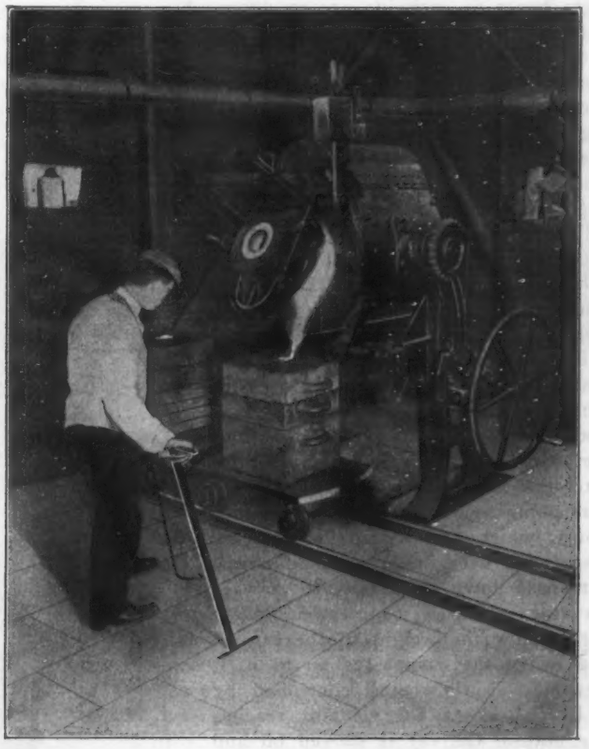


FIG. 5—FURNACE TILTED TO DRAIN OFF THE LAST OF THE METAL.

Electric Shovel Loading Iron Ore in Spain

Spain, one of the richest ore producing countries in the world, but whose progress in mining has been handicapped by lack of proper facilities and poor labor conditions, is learning the advantages of utilizing modern American types of equipment for handling this class of material.

An instance of this is furnished by the Compania Minera de Sierra Menera, an extensive mine owner, which has recently installed an electric shovel for loading iron ore from its stock piles near its shipping dock at Sagunto, Spain. Although American makes of steam shovels are being used in some parts of Spain, this is the first electrically - operated shovel that has been introduced in that country.

The shovel is of the Little Giant traction type built by the Vulcan Co., Toledo, O., weight about 35 tons and carries a 1¼-cubic yard dipper. It has a floor clearance of 25 feet and will dump 10 feet above ground. It is equipped with three direct current, 500-volt railway type motors; 60 horsepower for hoisting, 30 horsepower for swinging and 30 horsepower for thrusting.

The mines are located about 200 miles from tidewater and over a very mountainous road. The ore is loaded into 20-ton capacity bottom dump cars, of which twenty are made up into a train. Owing to the steep grades heavy 12-wheel four-cylinder locomotives are used in hauling these trains to the shipping point.

The ore is similar to that of the Mesabi range. There are about six different grades, and as there are no furnaces in that section, it is all exported. The company employs twenty-

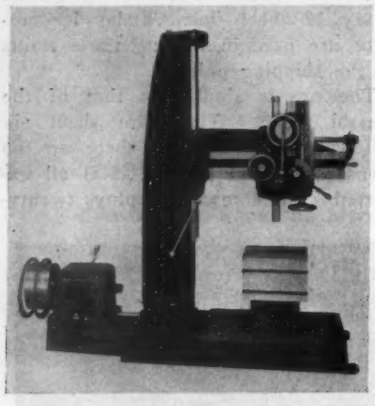
ELECTRICALLY OPERATED SHOVEL, BUILT BY THE VULCAN CO., TOLEDO, O., LOADING ORE FROM STOCK PILES INTO THE CARS IN SPAIN.

ANOTHER VIEW OF A 35-TON SHOVEL, LOADING ORE INTO CARS IN SPAIN.

eight boats to carry its ore to different parts. Those going to Glasgow and Germany carry from 3,500 to 4,700 tons, while those coming to America carry about 7,000 tons. If an incoming train is loaded with a grade of ore for which a vessel in port may be waiting the cars are taken to the dock and dumped direct into the vessel; if, however, a different grade of ore is required, the train of loaded cars is run out on a trestle and dumped into stock piles, each grade by itself.

From the stock piles the ore is reloaded by the shovel into 20-ton cars which are hauled to the shipping dock and hoisted by electrically - operated elevators and dumped through a chute into the vessel, one of these elevators going up while the other is going down, which permits of unloading a 20-ton car every minute. The empty cars pass down the trestle to another elevator which is counterweighted a little below the weight of the car, so that when the car passes on to it, it descends slowly, being controlled by a brake. When the elevator reaches the bottom the car is shoved off and the brake released, when the counterweight returns the car to the top.

The company owns its own power plant, blacksmith and machine shops and brass foundry and does all its own repair work. It employs about 700 men at the plant and stock piles and an equal number at the mines, where all the ore is at present mined by hand labor and loaded into small



New Gang Radial Drill.

baskets, which are passed from hand to hand to the cars. The use of the electric shovel will, however, reduce this force of men at the shipping point and stock piles about two thirds.

The Vulcan Co.'s representative, who went from Toledo to install the shovel, found conditions very different from those in the United States. Common labor is paid 50 cents per day and the working hours are from 5:00 a. m. to 8 a. m., with one-half hour for breakfast; from 8:30 a. m. to 12:00 noon followed by two hours intermission, and from 2:00 p. m. to 6:15 p. m. The cost of living is about the same as in the United States. Even after taking

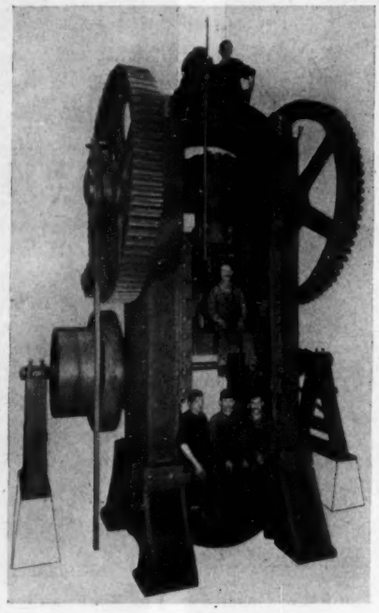


Fig. 1—Front View of Bliss Press.

into consideration the cheapness of labor, the company finds it more economical to use electric power shovels, as their power costs but 1 cent per kilowatt hour and the shovel has loaded one 20-ton car in seven minutes with an average of five 20-ton cars per hour.

The company is arranging to furnish additional power from its works at Valencia, a distance of 18 miles. Alternating current will be supplied at 10,000 volts and will be reduced by transformers to the proper voltage for the shovels. As soon as this is done additional shovels will be installed at the stock piles and will also be substituted for hand labor at the mines.

A New Radial Drill

The illustration presented herewith shows a new design of radial drill, built by the William E. Gang Co., Cincinnati. The machine is driven by a constant speed pulley through the speed box, which gives 12 changes of spindle speeds, ranging from 39 to 280 revolutions per minute. A feature of the machine is the new design of head, in which all gears are encased within the head casting, protecting them effectually from dust and retaining the lubricant. The spindle is driven at the lowest point on its largest diameter and is fitted with a quick hand movement in addition to the regular feeds, which are six in number, ranging from 0.007 to 0.036 inch per revolution, and all of which are instantly available through the feed lever on the front of the head. An automatic trip is also provided which disconnects the feed when the desired depth is reached.

Large Straight Side Press

The accompanying illustrations show a straight side, single crank press of unusual size, which has recently been built by the E. W. Bliss Co., New York, and which is believed to be the largest press of this type yet constructed. It illustrates the continually increasing tendency towards larger and heavier presses for the manufacture of heavy sheet metal stampings to replace articles formerly made of castings or for such stampings as have been heretofore made in hydraulic presses, the crank press method giving, it is claimed, a more uniform production in addition to effecting considerable economy in manufacture.

Fig. 1 is a front view of the press, which is of the built-up type of construction, in which the working stresses are taken by four large tie rods. The crank shaft is 16 inches in diameter and weighs 9,500 pounds. Power is transmitted to it at both ends, greatly reducing the torsional and bending strains. The slide, owing to

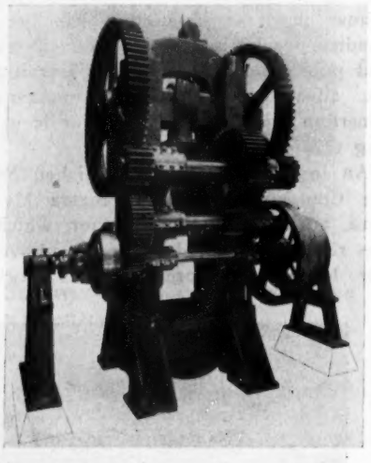


Fig. 2—Rear View of Press, Showing Driving Gear.

its great size and weight, is raised and lowered by a 4-horsepower motor mounted on the top of the press, power being transmitted from the motor to the worm and worm wheel adjustment through a vertical shaft fitted with knuckle joints.

Fig. 2 shows the rear of the press and the gear drive. The machine is triple-geared and the entire train of gears and pinions are of steel, cut, the

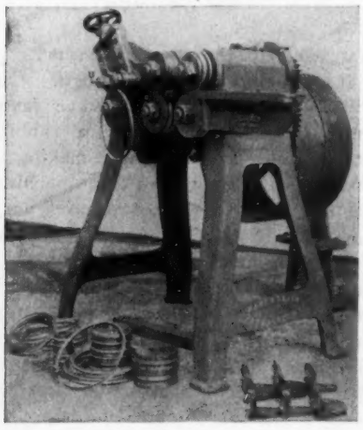
PLANT OF THE STETSON-ROSS MACHINE WORKS, SEATTLE.

large main gears each weighing about 13,000 pounds.

The machine is controlled by a hand lever operating a friction clutch designed especially for heavy duty. By means of this clutch the machine is always under instant control and may be stopped and started at any point of the stroke. Attached to the wheel is a safety coupling as a safety guard in case the press, through carelessness or otherwise, is subjected to a pressure greatly in excess of that for which it is designed. The total weight of the press is 190,000 pounds.

A Roll-Forming Machine

A machine designed to produce a variety of formed sections from flat stock is shown in the illustration presented herewith. The machine is arranged for forming-up small wheel rims. Flat stock is run into the machine from the right hand end, passing through two sets of forming rolls which produce a semi-circular section, adapted to receive a round rubber tire. From these forming rolls the stock passes through the adjustable bending rolls where the circular rim is formed. Any diameter of rim may be obtained by means of roll adjustment through the hand wheel shown, and when the rim drops out of the machine it is complete and ready for welding. This is accomplished in one operation.



KANE & ROACH ROLL-FORMING MACHINE.

The machine is built by Kane & Roach, Syracuse, N. Y., who claim that the machine has a capacity for handling stock at the rate of 100 to 150 feet per minute. By changing the rolls an almost infinite variety of shapes can be produced, and for extremely complicated shapes the machine is built with six and eight rolls. Straightening rolls are also provided for use in certain classes of work to straighten the stock after leaving the forming rolls.

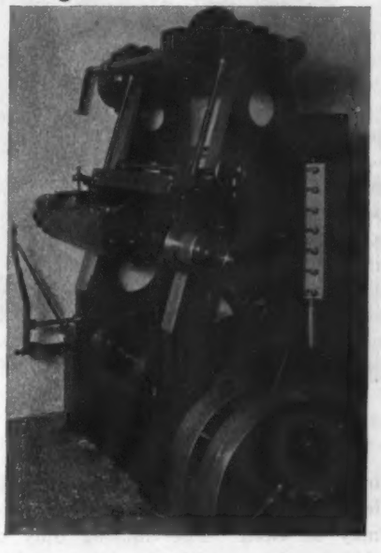
The arrangement of the bearings of the upper rolls to permit the use of different thicknesses of stock is ingenious. The roll shaft has a bearing in an eccentric sleeve which may be rotated to increase or diminish the distance between roll centers. The same arrangement, of course, may also be employed to vary the impression on the stock.

A Pacific Coast Woodworking Machinery Plant

Although the Pacific slope is now probably the largest lumber producing section of the United States, practically all of the machine tools, machinery, and equipment used in manufacturing plants and shops on the Pacific coast come from east of the Mississippi. This is gradually changing, however, and local manufacturers are demonstrating that machines adapted to local needs can be made successfully on the Pacific coast. Lumbering is the important industry in the states of Oregon and Washington, and nearly all the lumber manufactured is Douglas fir, which grows much larger than the eastern and southern timber and saw mill machinery must accordingly be particularly designed for the Pacific coast.

One of the plants which have come into existence for the local manufacture of woodworking machinery is that of the Stetson-Ross Machine Works, Seattle, which began as a specialty the manufacture of planers a little over a year ago, and has found a ready market for its product.

In the design of planers for handling the larger timbers of the Pacific slope, strength and simplicity come first and convenience of operation and ability to plane lumber 10 hours a day are the next considerations.



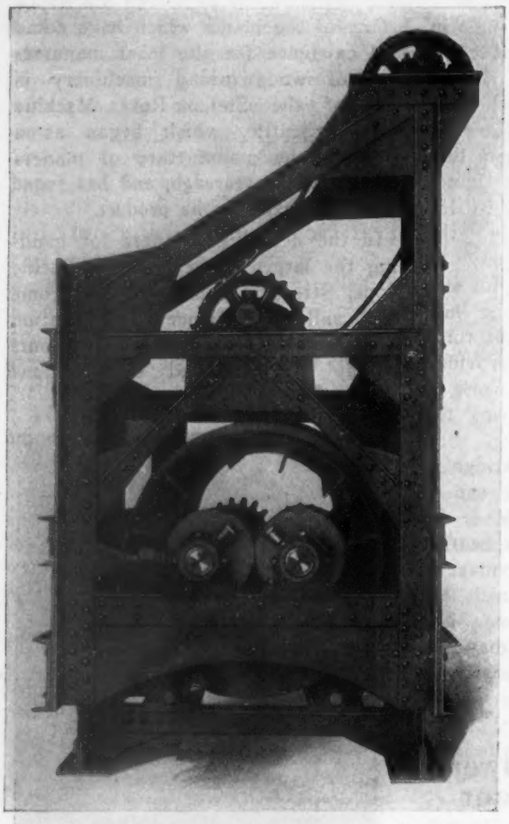
HOUSING OF A LARGE TRAVELING BED PLANER.

The line of planers has accordingly been specially designed to meet conditions which do not confront the eastern and southern manufacturer.

The main factory building of the Stetson-Ross plant is 300 x 100 feet with galleries running full length on either side of the main erecting floor. The pattern storage and the light machine tools are in the galleries, while the heavy machine tools occupy

the first floor. One end of one wing contains the company's offices and the other the wash rooms for the men. Completed machines are loaded directly from the main floor on to cars on a spur track running alongside the shop. The larger machine tools are Lodge-Shipley patent head lathes with a number of automatics for duplicate work. The large machines have individual motor drive, while the smaller ones are arranged in motor-driven groups. Jigs and templets are used throughout to produce interchangeable work.

As an instance of the size of material to be dealt with a traveling bed planer made to work up to 30 x 30 inches and up to 100 feet or more in length, which is a standard product, may be cited. The housing only of this machine, without the traveling bed, is shown in the accompanying illustration.



SAND-MIXING AND BLENDING PLANT FOR STEEL FOUNDRIES.

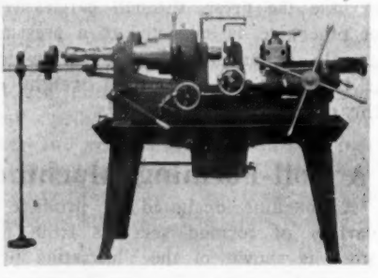
Besides being, it is said, the only firm west of the Mississippi to manufacture a line of planers the Stetson-Ross Co. is one of the very few machine manufacturers in the far northwest and the class of work done is significant. The finish is equal to machine tool work and it is said the locally built machines command a higher figure than eastern built product. The west, however, with its higher labor cost and higher cost of raw material, cannot compete with eastern manufacturers unless the product possesses superior advantages. For example, an average of ten principal eastern cities gives the average wage paid machinists as 33 cents per hour as against 42½ cents in Seattle.

Sand Mixing and Blending Plant

A large sand-mixing and blending plant for preparing sand for steel foundries, having a capacity of 15 tons per hour, built by the Standard Sand & Machine Co., Cleveland, is shown in the accompanying illustration. This machine consists primarily of a steel drum, made of rolled, ¼ inch plate, and is 48 inches in diameter and 76 inches long. To the interior of the drum and extending its entire length are attached 12 buckets which are riveted to the shell. The drum is slightly inclined toward the discharge end shown in this view, and the sand from the time of entering the drum to its discharge is carried up by the buckets and passed through the rollers 18 times in its travel from one end of the drum to the other. The sand after being mixed, tempered and screened, is delivered to the drum by means of a spout. The two rolls inside of the drum are 72 inches long and 16 inches in diameter, which roll the sand, thus imparting to it additional strength. The complete plant consists of a proportioning machine, in which various grades of sand can be mixed or dry core compound can be added as desired. To accomplish this, feed hoppers are placed on the ground level from which the sand is delivered, after being proportioned, by a bucket elevator to the spout of the machine which delivers the sand to the drum. If screening is desired a screen of any mesh can be provided, which will discharge foreign material at the side of the machine. For screening and tempering the sand a continuous mixer is provided, fitted with a spraying pipe and water tank, which is equipped with a gage to regulate the amount of water used for tempering. A steam heater and an air pressure spraying device for applying liquid core compounds for preparing core mixtures can also be furnished with this machine if desired.

This plant accomplishes the mixing, tempering, screening, blending and rolling of old and new sands for core, facing and heap sands used in steel foundries. The rolling process does not break up the grains of sand and on account of the thorough mixing and blending a smaller amount of binder and facing material is required. The rolling of the sand after it has been screened, mixed and tempered insures uniformity, all of the grains having received the same treatment. As a result of this a larger percentage of old sand can be used in the mixtures.

The drum revolves on trunnions, being driven by two gears which mesh with a gear extending around its circumference. The two rolls, through which the sand is passed, are tapered on the feed end and are corrugated to catch coarse material which may have passed through the screen, such as old cores, etc. One roll is fitted with springs, which enables it to adjust itself to the quantity of material that is being passed through. One roll is also geared to revolve faster than the other, imparting a rubbing pressure to the material, making it smooth and porous. These machines are built in sizes with capacities varying from 1 to 15 tons of sand per hour. The power required for operating the larger plants is approximately one horsepower per hour per ton of material. All bearings are made of phosphor bronze, the frame is of structural steel construction and the gears are machine cut.



DRESES ONE INCH FRICTION-GEARED SCREW MACHINE.

A Friction, Back-Geared Screw Machine

The accompanying illustration shows a 1 inch screw machine, built by the Dreses Machine Tool Co., Cincinnati. In this machine the head and bed are cast in one piece and the friction gearing is entirely inclosed. The frictions are of the toggle joint type, arranged so that the operating mechanism may be entirely

removed or restored without removing the spindle. The chucking and stock feeding device is of the familiar type, but the operating mechanism has been simplified for more convenient handling. A turret slide is provided with six stops, one for each hole, the stop mechanism being placed at the front on the outside of the top slide. A geared, four-change power feed is provided at the rear of the bed and is operated through the small crank shown at the front of the head stock. The cutting-off rest has a longitudinal movement on the bed and the tool posts are so designed as to bring the tools close up to the chuck. The pan is of unusual depth and the tail end leg is attached with a hinged joint, which gives the effect of a three-point erated through the small crank, shown weighs about 1,200 pounds, and ¾ inch, 1½-inch and 2¼-inch sizes are also built.

Works of the Austro-American Magnesite Co.

A new magnesite property is being developed in the province of Carinthia, Austria by the Austro-American Magnesite Co., a subsidiary corporation of the American Refractories Co., Chicago. The quarry covers approximately 1,500 acres and is estimated to contain over 15,400,000 tons of raw magnesite. An extensive plant for preparing the raw material and shipping the product has been built on the property and commencing Jan. 1 this year calcined magnesite will be shipped at the rate of from 65,000 to 70,000 tons annually. The major portion of this tonnage will be sold in the United States and the remainder shipped to steel producing centers in Great Britain and various parts of Europe.

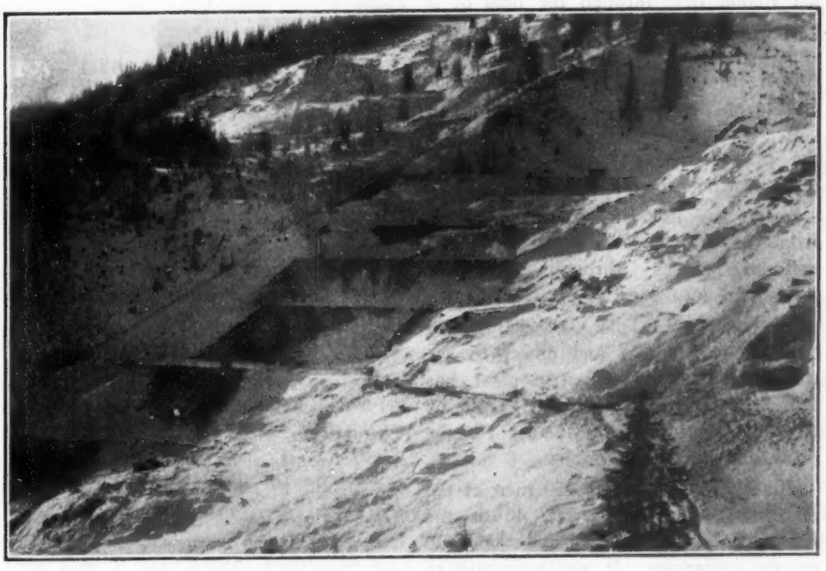


FIG. 1—MAGNESITE QUARRIES IN THE ALPS, AUSTRIA. THE CABLEWAY IS AT THE LEFT OF THE TERRACES.

The new quarry is near Radenthein, some distance southwest of the old Austrian works, which are in Styria province, and is exceptionally favorably situated for water shipment being only 36½ miles north of the port of Trieste at the head of the Adriatic Sea. The exact location of the quarry is at Bruch station on the north slope of the Millstatter Alps, about four miles north of the village of Radenthein near the foot of Lake Millstatter and 10 miles north of Ferndorf on the Sudbahn railway in the valley of the Drau river. It was discovered three years ago.

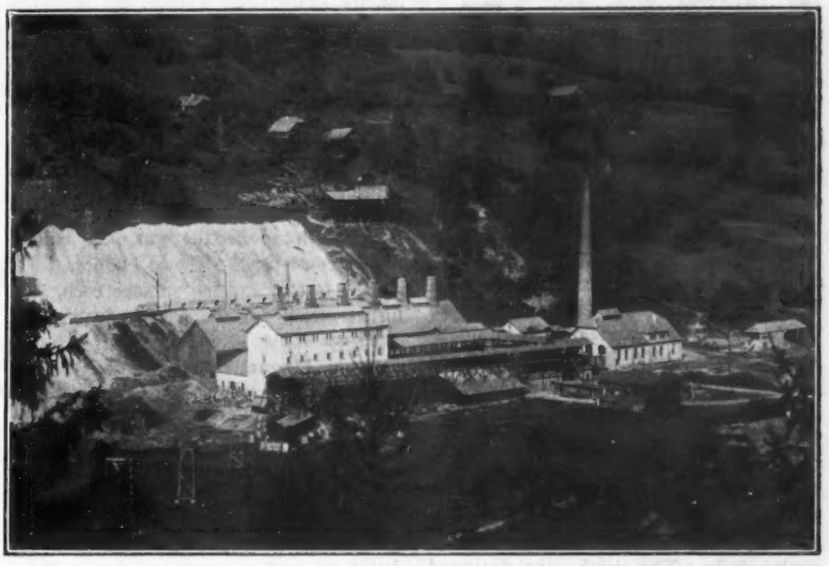


FIG. 2—CALCINING PLANT NEAR RADENTHEIN. STOCK PILES OF RAW MAGNESITE AND TERMINUS OF CABLEWAY TO QUARRIES ARE SHOWN ON THE HILLSIDE IN BACK OF THE PLANT.

The magnesite is of the spathic variety and lies on the face of the mountain at an elevation of 4,800 feet. The strata are 100 feet thick bedded on sub-strata of micaceous schist. The material is removed from open cuts. The quarry, Fig. 1, is laid out in 20 terraces, 13 of which are being worked at present. The quality of the magnesite is well suited to the requirements of the steel industry. The following analysis gives the composition of an average sample of the calcined magnesite produced up to Nov. 1, 1910:

	Per cent.
Magnesium oxide, MgO	89.50
Iron oxide, Fe_2O_3	4.40
Aluminum oxide, Al_2O_3	1.85
Silica, $Si\ O_2$	2.41
Lime, CaO	2.40
Volatile matter	.25

As is well known, pure magnesite is not suitable for use in furnace work, a certain per cent of impurities, particularly iron oxide being necessary. Attention is called to the high percentage of magnesium oxide shown in the analysis. This is an advantage generally possessed by new workings, since the quality of the magnesite usually deteriorates as the quarry becomes exhausted. The following table showing the decrease in magnesium oxide in one of the

older magnesite quarries in Austria illustrates this point:

Average analysis in—	Per cent, MgO.
1899	87.35
1900	85.15
1901	84.84
1902	84.52
1903	83.91
1904	76.31
1905	81.04
1906	79.11
1907	79.04
1908	80.84

To transport the magnesite from the quarry to the reduction plant at Radenthein, 4 miles south, two aerial cableways built by J. Pohlig & Co., Cologne, Germany, are used. The cableways are operated by gravity, the elevation of the loading station being 4,850 feet and of the unloading station, 2,300 feet, making the average grade 12 per cent. They are designed for a maximum capacity of 1,200 tons per ten-hour day. Since one pound of raw magnesite is required to produce a half pound of sintered magnesite, this would mean an output of 600 tons of sinter magnesite daily. The works are designed for this capacity.

A general view of the reduction plant is shown in Fig. 2. Twelve kilns with a daily production of about 20 tons each have been put up. Others are under construction and it is intended to have the works in full operation by the end of 1911.

Producer Gas-fired Kilns.

Contrary to the usual practice of firing the kilns with coal, the Radenthein works are using producer gas. The advantages of gas firing are twofold: On one hand, a higher temperature may be reached with a lower rate of coal consumption, and on the other hand, the combustion is more complete, thus avoiding waste gases which are injurious to all vegetation in the neighborhood of the works. The height of the latest kilns from the floor to the charging doors is 56 feet and they are topped by a 17-foot chimney making their total height 73 feet.

Four times a day, the calcined magnesite is drawn from the lower doors of the kiln, from which it drops into a cooling pit. A part of the air needed for the combustion of the gas passes up through the pit, cooling the magnesite which in turn heats the air to 1,100 degrees. The pit thus serves as a regenerator. Four high pressure fans driven by electric motors furnish the blast necessary for the combustion. A blast pressure equivalent to 20 inches of water is carried.

The gas is furnished by nine gas producers. The kilns now under constuction will be provided with Rehmann producers fitted with self-acting cinder removers, similar in general design to the Kerpley producers, well known in Europe. These producers have revolving grates, which grind the cinders and automatically remove them through the water-lock. The Rehmann type differs from the Kerpley only in the grate, which is fitted with three protruding cones having slits for the entrance of air. During the revolution of the grate, the cones keep the coal in motion. This motion removes the cinders and also prevents stratification of the fuel bed, which spoils the gas. A boiler-plant consisting of two boilers, 300 square feet of heating surface each, furnishes steam for the gas producers.

Magnetic Separators.

After the material is taken out of the cooling pit, it is placed on the sinter magnesite storage pile, where it remains for some time to cool. It is then taken to the separating plant where it is crushed in stone crushers and reduced by rollers until the grains have a maximum diameter of 0.393 inch. Bucket conveyors elevate the crushed magnesite to the top floor of the four-story separation building and on its way back to the ground floor it passes the magnetic separators. This process is based upon the fact that the magnesite becomes magnetic by being burned, the iron contained in it oxidizing to ferric oxide, Fe_2O_3. The material in a broad flat ribbon falls through the field of a powerful electro-magnet which diverts and separates the magnetic particles. At present there are eight of these separators in operation; they are used in batteries of two and the waste from the first separator passes the second, thus insuring complete separation.

Sifters are used to separate the dust from the grains. From the sifters the material passes through automatic scales and into bags.

A steam power plant of 400 horsepower supplies light and power to the works, and a hydro-electric plant has also been built. A saw mill, driven by electric power furnishes lumber for the plant and the quarry.

The company employs 250 men at the plant, 200 at the quarries, 40 at the Ferndorf loading station and about 10 on the cableways. It was necessary to build accommodations for the men and to establish a commissary on the ground.

The sintered magnesite packed in bags is carried from the plant at Radenthein to the railway station at Ferndorf by a second gravity cableway 5½ miles in length. Three bags of magnesite are carried in each of the cableway buckets, which are loaded with coal for the plant, returning. Since the weight of coal consumed is only 35 per cent of the weight of magnesite delivered, this cableway requires no external power.

At the port of Trieste, a warehouse is operated. Contracts have been made with the Austro-American Steamship line to ship the magnesite to this country. Monthly sailings are made to New Orleans, weekly to New York and every 10 days to Philadelphia. The company carries stocks of magnesite in warehouses at Philadelphia and New Orleans, about 32,000 tons being carried in stock.

The Austro-American Magnesite Co. is stated to be the only corporation controlled entirely by American capital operating magnesite properties in Europe. Its developments are of interest to the iron and steel trade on account of the increasing demand for magnesite in this carries about 32,000 tons of magnesite in stock in warehouses at Philadelphia and New Orleans.

	Tons.
1902	41,630
1903	49,244
1904	36,014
1905	63,633
1907	90,000
1910 (estimated)	100,000

The number of places throughout the world where magnesite of the proper quality for use in steel furnaces is found are not numerous and the opening of the Millstatter deposits described in this article adds an appreciable tonnage to the known supply of this material.

New Catalogs

RAIL WELDING.—A 16-page pamphlet has been issued by the Goldschmidt-Thermit Co., New York, and is devoted to the subject of welding rails by the Thermit process.

POWER FROM WASTE HEAT.—Bulletin 132, issued by The Green Fuel Economizer Co., Matteawan, N. Y., treats of the subject of power for cement mills by utilizing the waste heat from the kilns.

TITANIUM ALLOYS.—The Titanium Alloy Mfg. Co., Pittsburg, has issued a 21-page booklet entitled "Titanium in Steel," setting forth the advantage to be obtained in the use of this alloy and the most convenient methods of use.

PUMPS.—The Buffalo Steam Pump Co. has issued Catalog No. 229, 64, 6 x 9-inch pages, which is devoted to Buffalo power pumps, both vertical and horizontal, single, duplex and triple types. Other types of pump made by the company are also given brief mention.

ELECTRIC APPARATUS.—Bulletins No. 120, 122, 123 and 125, issued by the Crocker-Wheeler Co., Ampere, N. J., describe, respectively, Form I belt type direct current motors and generators up to 50 horsepower and 45 kilowatts, Form D belt type direct current motors and generators from 25 to 300 horsepower and 45 to 150 kilowatts, adjustable speed motors, 5 to 32 horsepower, and Remek transformers.